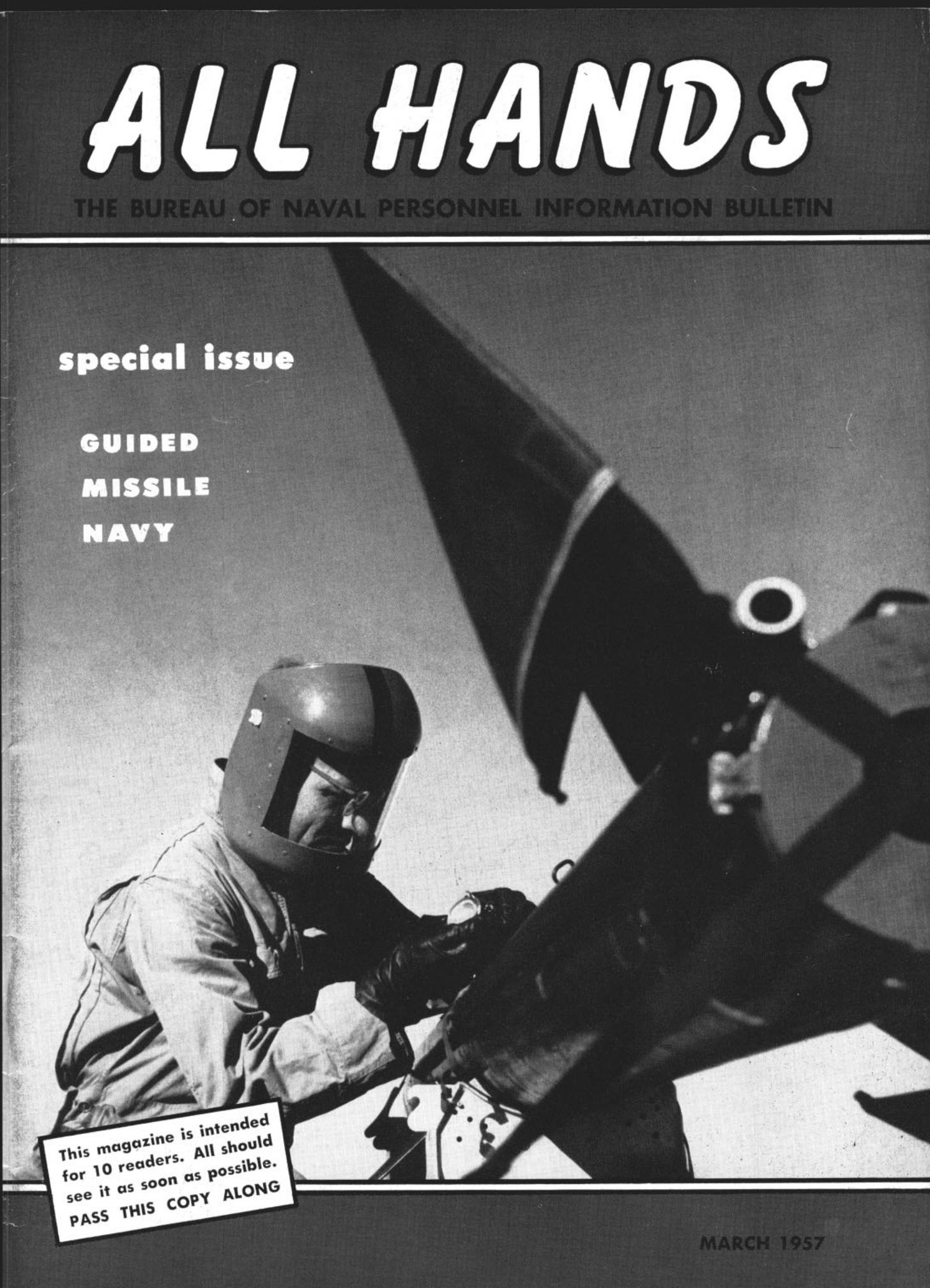


# ALL HANDS

THE BUREAU OF NAVAL PERSONNEL INFORMATION BULLETIN

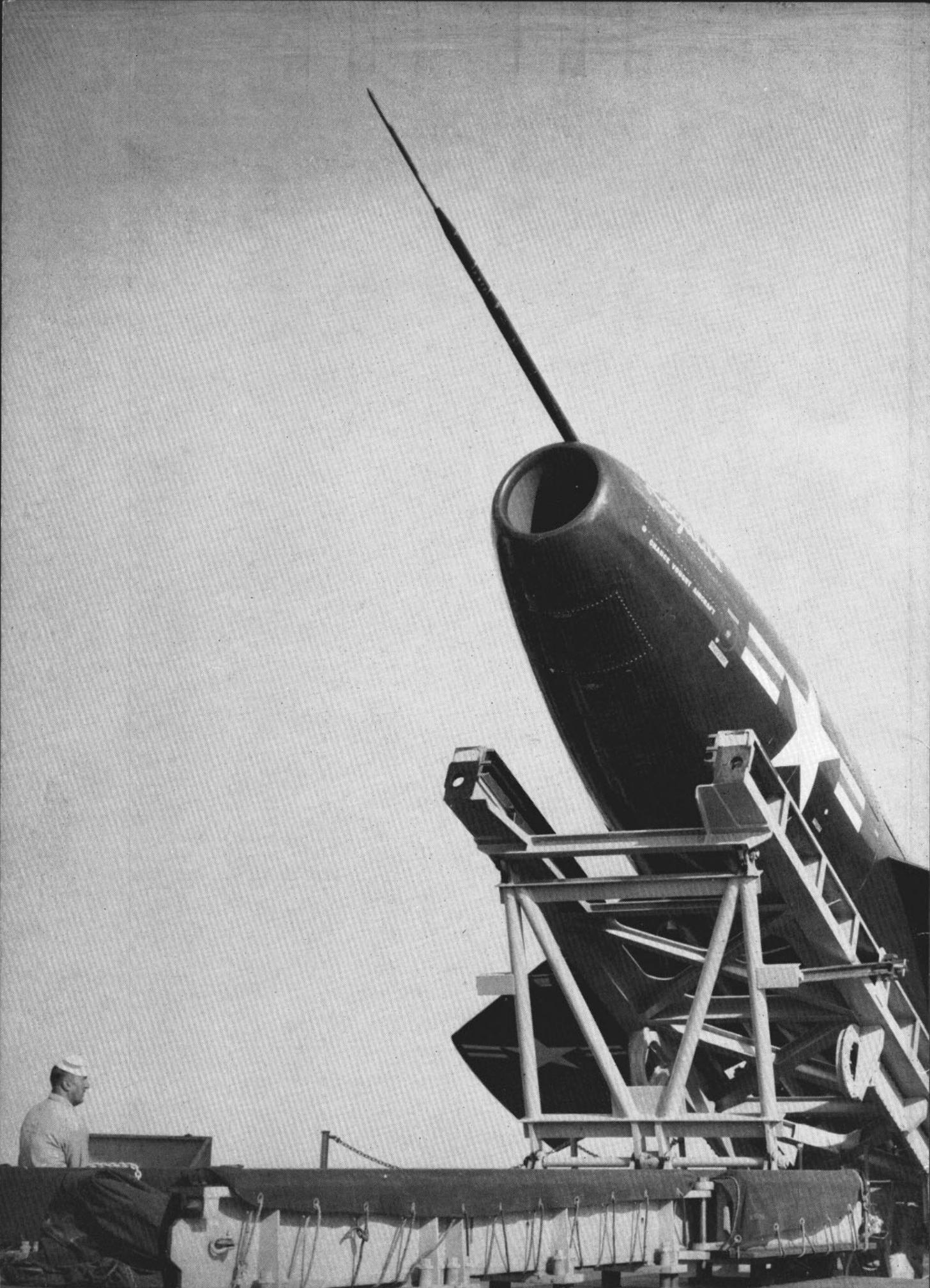
**special issue**

**GUIDED  
MISSILE  
NAVY**



This magazine is intended  
for 10 readers. All should  
see it as soon as possible.  
**PASS THIS COPY ALONG**

MARCH 1957



# ALL HANDS

THE BUREAU OF NAVAL PERSONNEL INFORMATION BULLETIN

MARCH 1957 Nav-Pers-O NUMBER 482

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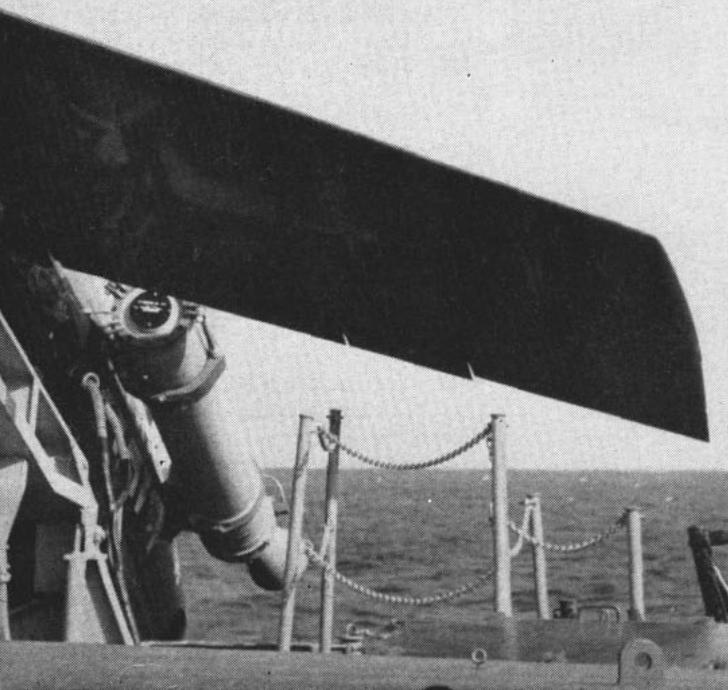
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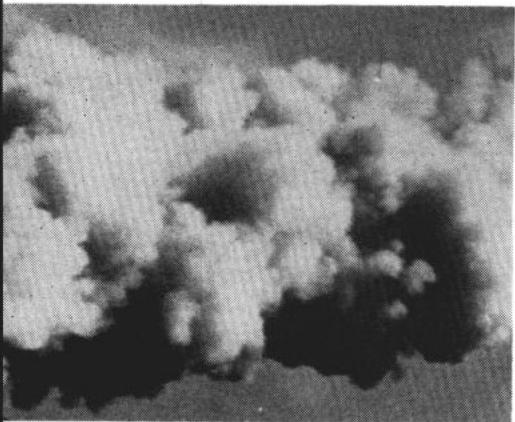
Don Addor, Layout

● AT LEFT: ALL SET TO GO—Navy's versatile guided missile *Regulus* rests in shipboard launcher at full height for firing. This surface-to-surface missile can be fired from cruisers, aircraft carriers and submarines.

● FRONT COVER: FOR THE 'BIRDS'—C. M. Leque, AO1, USN, inserts spotting charge in *Sparrow* guided missile prior to loading operations at NAS Miramar, California.

● CREDITS: All photographs published in ALL HANDS are official Department of Defense Photos unless otherwise designated. Photos of *Polaris* on page 21 by AFPS—World Wide.





## NAVY'S

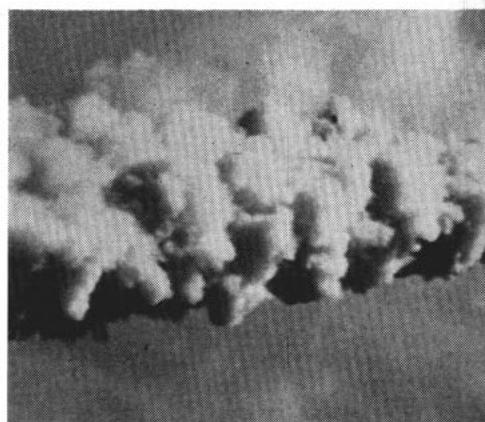
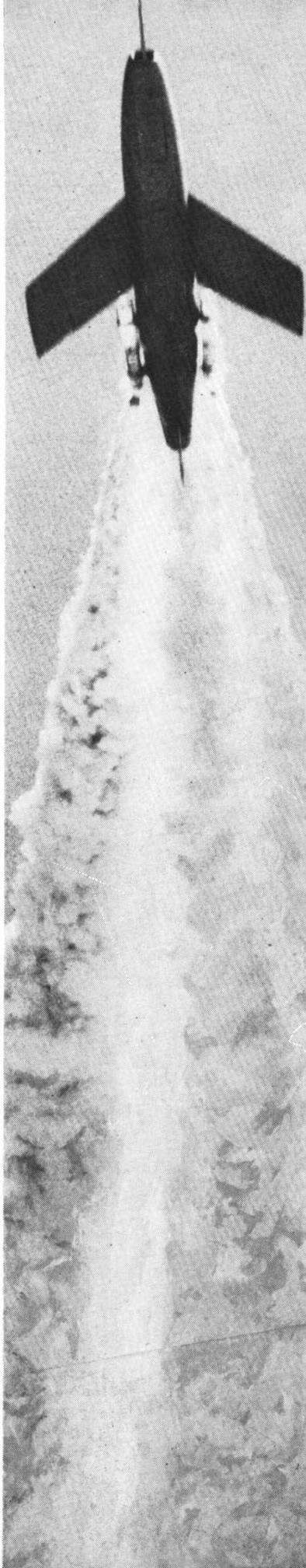
**I**N 1945 THE ATOMIC BOMB flashed upon the world scene in a blaze of devastation that made it, by far, the most spectacular weapon to come out of World War II. But, today another weapon which saw its first real action in that conflict is getting just as much attention.

As any Navyman who knows port from starboard will tell you, this is the guided missile. And, if you've been reading the newspapers lately, you're probably aware that the United States is putting millions of dollars into research and production in this vital field of national defense.

Because of that sound investment and a lot of hard work by civilian scientists and men in uniform, the U. S. Navy has become the first military service in the world to hold a full house in these eerie new weapons.

As a surface-to-surface missile we have *Regulus*, which has been in quantity production for several years. In the surface-to-air category we have the *Terrier*, ready to jump to the nation's defense as the armament of our first guided missile cruisers and destroyers. For air-to-air use we have *Sparrow*—slung beneath the wings of sleek Navy fighters like the F3D-2M *Skyknight* and F7U-3M *Cutlass*—and *Sidewinder*, carried by fighter and attack squadrons with the Sixth Fleet in the Mediterranean and the Seventh Fleet in the Western Pacific. And, as an air-to-surface weapon we have *Petrel*, which can be launched against enemy ships and submarines by patrol planes far out of range of the target's anti-aircraft fire.

Besides these, there are a flock of other guided missiles on the way. In



## GUIDED

early 1958 *USS Galveston* (CLG 93) is scheduled to rejoin the Fleet after being converted into our first cruiser armed with the long-range, surface-to-air *Talos*. *Polaris*, a surface-to-surface intermediate range ballistic missile, should be operational in about five years.

*Tartar*, a surface-to-air missile smaller and less expensive than *Terrier*, should soon be ready for use aboard destroyers and in the secondary batteries of larger ships.

That's quite a lineup, considering all the effort that goes into the development of just one successful missile, but as the circus barker used to say, "That's only the beginning, folks. That's only the beginning."

In the next few years, guided missiles will become more and more important to our national defense—and ever-increasing numbers of Navy men will be affected by this revolution in the concept of warfare.

Therefore, it might be a pretty good idea to take a closer look at these death-dealing gadgets.

### What's A Guided Missile?

First of all, let's find a definition. And for that we go to the one accepted in OpNav Instruction 3020.1A, which calls it "an unmanned vehicle moving above the earth's surface, whose trajectory of flight path is capable of being altered by a mechanism within the vehicle."

In the book by Nels A. Parson, Jr., "Guided Missiles in War and Peace," a guided missile is referred to as a robot device that can be directed to a target by commands originating from outside the weapon or by instruments built into it. To



- ASMs are named after sea birds.
- SSMs bear astronomical names.
- SAMs are named for mythological characters.

Thus, in air-to-air missiles we have *Sidewinder*, named for a deadly rattlesnake of the desert, and the harmless-sounding *Sparrow*. In the air-to-surface type there's *Petrel*, which gets its moniker from the far-flying, long-winged sea birds sometimes known as stormy petrels or Mother Carey's Chickens.

*Talos* gets its name from Greek mythology. Talos was a man of brass given to the king of Crete to guard that island, which Talos did by walking around the island three times every day.

Where an SSM name occurs in both astronomy and mythology only the astronomical name is used. *Polaris*, of course, is the North Star, but *Regulus*, besides being the name of a star, was a popular name in the middle ages for a snake which was supposed to kill by its hiss.

You can't always judge a missile by its name, however. *Tartar* doesn't

follow the pattern and neither does *Terrier*, for as everyone knows, a terrier "ain't nuthin' but a hound dog" (or at least a type of dog).

#### What Goes Into A Guided Missile

No matter what you call them, all guided missiles are made up of four basic components—the *airframe*, the *power plant*, the *guidance and control system* and the *warhead and fuses*.

"Airframe" has the same meaning among missilemen as it does among aviators. This is the component which gives the missile its aerodynamic characteristics, and the part in which the other components are placed. Designing the airframe and finding the right material from which to make it, involves thousands of man-hours during the research and development phases of a missile's creation. At present, most airframes are made of aluminum alloys, magnesium or high tensile strength steel, but a never-ending search goes on in an effort to give the airframe the heat resistance, strength, lightness and other qualities it requires. Heat

# MISSILES

be truly guided, the craft must be capable of changing its course to take account of unpredictable factors or evasive movement of the target. Control devices and propulsion systems used in guided missiles are found in two other types of robot craft as well. The first is an early cousin of the guided missile—the preset missile that can only maintain a predetermined direction, position, or attitude with respect to a fixed reference. The conventional naval torpedo and the German V-1 and V-2 missiles are examples. The second is the remote-controlled pilotless vehicle which is not built for the purpose of attacking a target. Drone aircraft used for reconnaissance and in anti-aircraft target practice, and space ships of the future, are examples of this type.

"By common usage the term guided missile means a robot craft that flies through air or space."

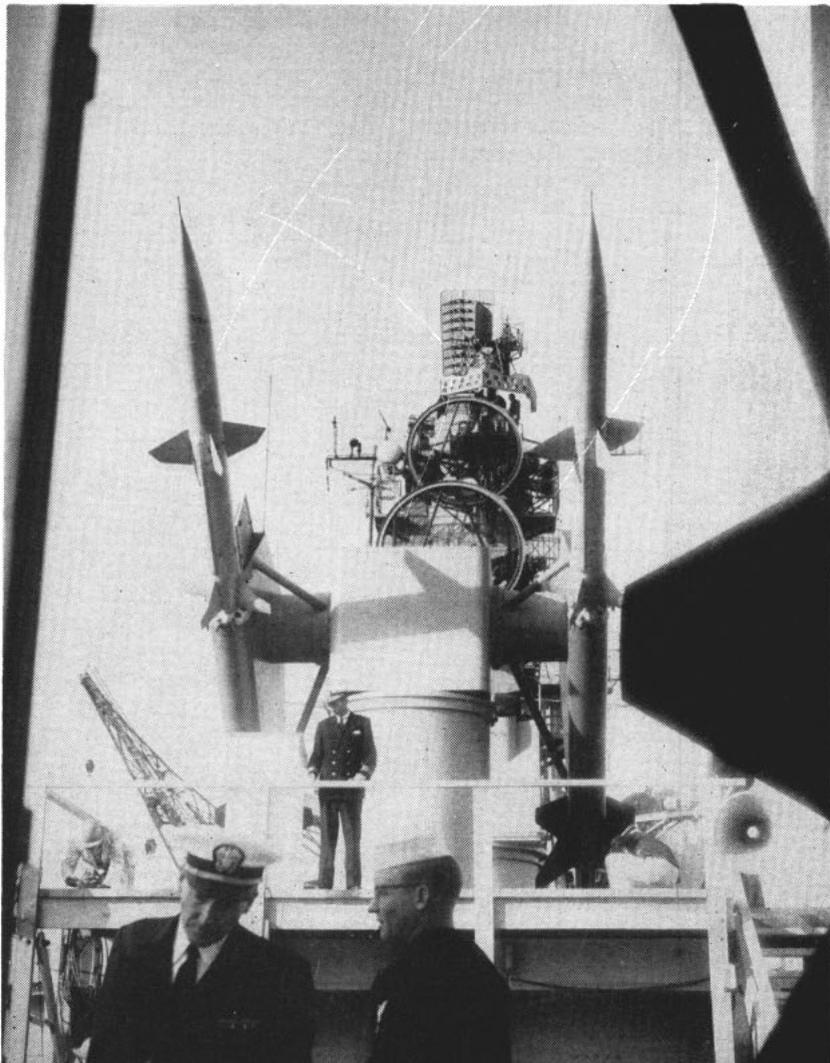
These birds are classified by type according to location of target and location of launcher. Therefore, a missile launched from the air (A) against a target on the sea or earth's surface (S) is called an air-to-surface missile, or in abbreviated form, an ASM. Similarly, a surface-to-air missile becomes an SAM, a surface-to-surface missile is an SSM and an air-to-air missile is an AAM. In general usage these four types cover the field.

#### How They Get Their Names

Usually the Navy follows an informal system in picking the names for its prize birds:

- AAMs are named for reptiles and winged creatures (except birds of prey).

SURFACE-TO-AIR *Terrier* missiles arm GM ships against enemy air attacks.



resistance is especially important, for one of the biggest problems now facing the researchers is that of finding a material able to withstand the terrific heat generated by the friction of air moving over the missile's outer surface.

Naturally, speed is an absolute essential for a guided missile. If the bird is an offensive weapon, it must be able to outrace the planes and missiles the enemy sends up to intercept it. If it's a defensive one, it must move faster than the planes or missiles the attacker is using.

#### The Power Plant

Because of this "need for speed" all power plants used in guided missiles are based on some form of the thermal jet engine—usually a solid or liquid propellant rocket, a turbojet or a ramjet.

Each of these power plants has its own advantages and disadvantages. Since rocket engines carry their own oxygen, altitude has little effect on them, so the rocket is the ideal power plant for use beyond the earth's atmosphere. Rockets also offer, at least theoretically, the possibility of unlimited speed. However, their high rate of fuel consumption and the difficulties involved in steering a rocket, present problems which have yet to be solved.

The ramjet has a lower rate of fuel consumption, and therefore a longer range, than the rocket, and it can be run on gasoline or kerosene, instead of the expensive and hard-to-handle fuels used in rockets.

But, it can't operate beyond the earth's atmosphere and it doesn't work at its best until it reaches supersonic speeds. For that reason the ramjet has to be launched from a fast airplane, or assisted by a rocket booster when surface-launched.

The turbojet requires less fuel than either the rocket or ramjet and requires no assistance in its takeoff. On the other hand, though, its basic weight is a serious drawback for long-range use and it's a complicated and expensive type of motor to use in a one-way operation.

#### Guide To A Missile

The difficulties involved in finding the right airframe and power plant are big ones, but they're minor compared to the complexities of guidance. Usually, the various types of guidance systems are classified into four major groups—self-contained, beam-rider and command, baseline and homing.

- The self-contained group, as the name implies, includes those systems in which intelligence is entirely within the missile.

The major types in this category are the preset, magnetic, inertial and stellar-navigation systems.

In preset systems a predetermined path is set into the control mechanism of the vehicle and the missile cannot "change its mind" once it is launched.

Magnetic systems use some natural phenomenon of the earth to control the missile's flight path. The

German V-1, for example, used a simple magnetic compass to correct the bearing of the missile when it strayed from its preset heading.

In most inertial systems, complicated devices (called double-integrating accelerometers) measure the distance the missile has traveled in range and side-to-side and up-and-down deviations from the preset flight path. Then, based on these measurements, the control setup automatically returns the missile to its desired course.

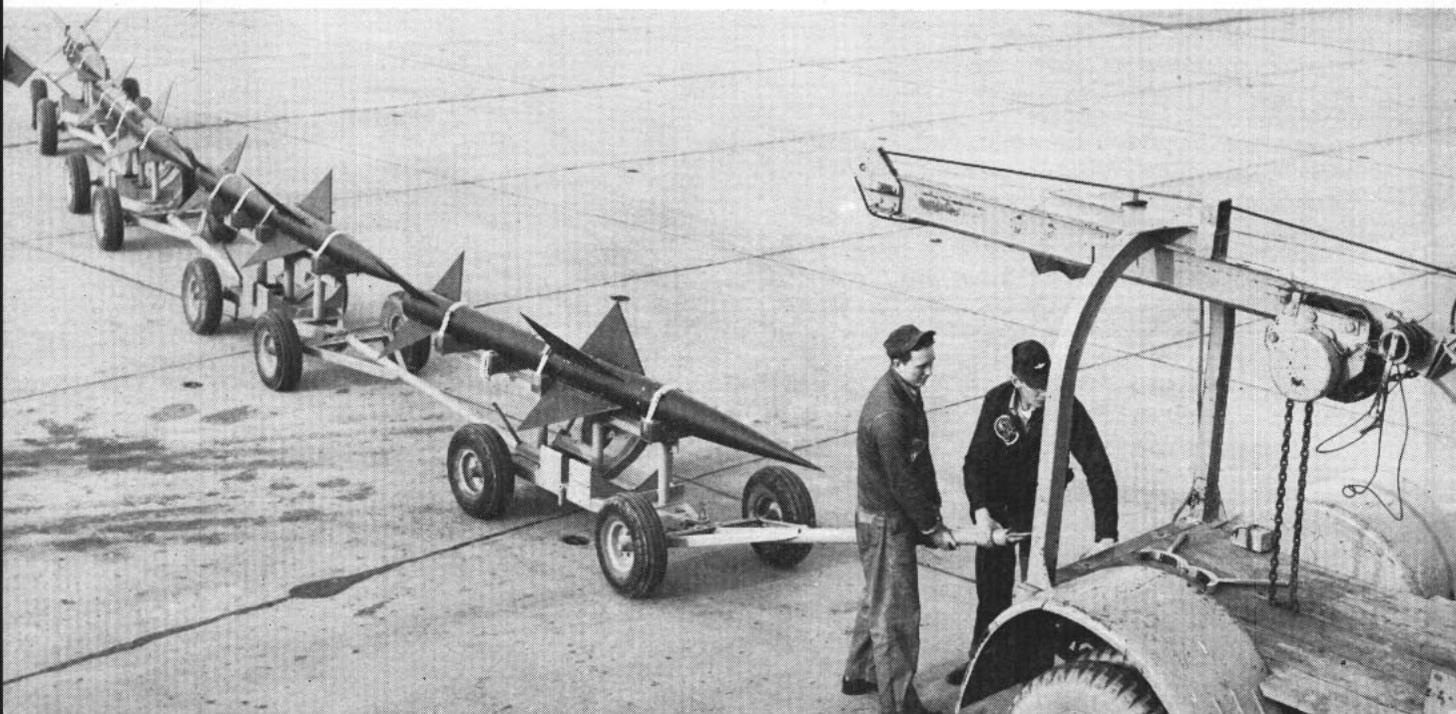
In stellar navigation systems, devices in the missile are set to sight certain stars and calculate the missile's position so that the missile will automatically navigate itself according to preset "instructions."

- The beam-rider and command group of guidance systems is composed, of course, of beam-rider and command systems and modifications.

In the simplest type of beam-riding the target is tracked by some sort of beam, usually radar, and the missile follows the tracking beam until it collides with the target. A modification of this system uses two radars—one to track the target and the other to give the missile a beam which will direct it to a predicted point of collision.

In command guidance systems the target and missile are tracked independently, the missile's flight path is computed from the tracking data and other information and radio or radar command signals are used to steer the missile to a point of collision. Some missiles in this category

MISSILE TRAIN — Missilemen move out Sparrows to be loaded in the wing launchers of Navy Cutlasses at VA-86.



carry television cameras which furnish the operator a picture of what the missile "sees" and enable him to steer the missile accordingly.

- In baseline guidance, techniques similar to those used in aircraft electronic navigation are employed to direct the missile to its target. In one example of this group, based on the same principle as loran, radio waves are sent out from two transmitters and the missile follows a beam formed by the intersections of the waves.

- In homing systems all the guidance equipment is located in the missile and the missile "homes in" on some illuminating target feature, such as heat, light, sound or magnetic field. The homers can also direct themselves toward a transmitting radio, radar, or television station, or they can guide themselves by radar echoes reflected from the target.

That, very, very, briefly covers the airframe, the power plant and the control and guidance system. But the missile's real reason-for-being is its fourth component—the warhead and the impact, proximity or ground-control fuse which detonates it.

#### The Punch In A Guided Missile

Eventually, a missile might carry any of these warheads:

External blast—In which the pressure wave generated by the force of the explosion does the damage.

Fragmentation—In which the explosive force ejects metallic fragments at high velocities.

Shaped charge—In which the explosive force is pointed in one direction and damage is produced either by the force of the blast or by fragments ejected.

Explosive pellet—In which separately fused pellets would be ejected from the warhead to detonate either on impact with, or after penetration of, the target.

Nuclear—An atomic missile could destroy military targets while at the same time releasing radio-active elements. An atomic or hydrogen bomb would be an awesome weapon even if it were dropped from a World War I "Jenny." But, when one of these killers can be carried in a vehicle moving at several thousand miles per hour, its lethal power is multiplied tremendously.

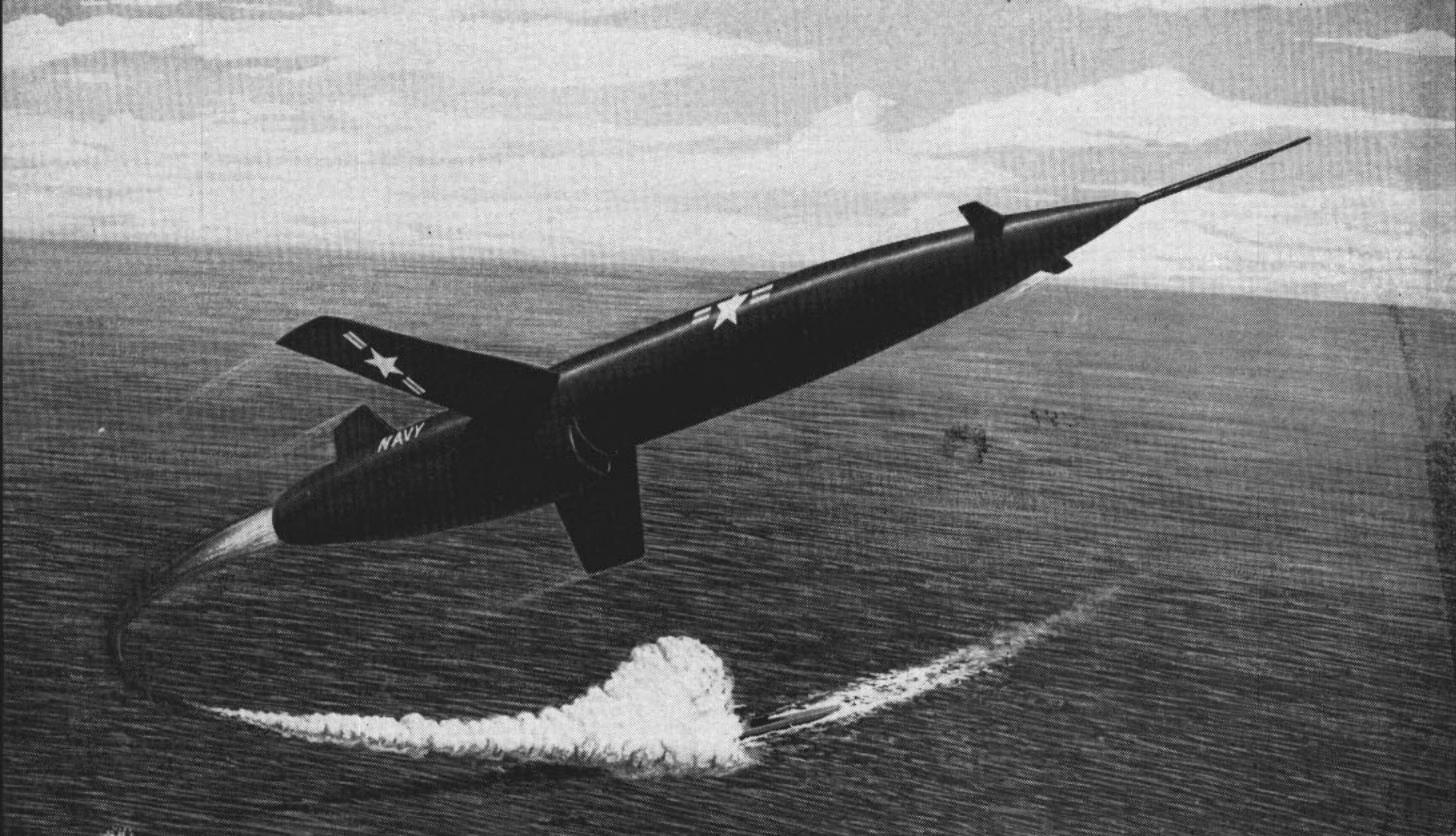
Keeping that fact in mind, the Navy is going all-out to help the United States keep its lead in the guided missile field. —Jerry Wolff



POISED FOR ACTION — An F9F-8 Cougar hovers like a peaceful but alert hornet, ready to strike in defense if necessary with its Sidewinder 'stingers.'



UP FROM BELOW—Guided missile submarine USS Tunny (SSG 282) prepared to launch *Regulus* from her deck using JATO bottles for initial flying speed.



MISSILE OF TOMORROW — Regulus II, big brother of the now operational Regulus, is shown in artist's conception.

## Impact of Missiles on Ships

"IT IS INTERESTING, if not amusing, to note that the introduction of the *rifled gun*, the *torpedo*, the *aerial bomb*, and *atomic weapons* were each accompanied by the prediction that the surface Navy would become obsolete." These words, written by an Army officer in a book considering the potentialities and effects of guided missiles, served to introduce the statement that as these implements of war were developed each one was "tested against naval vessels, yet the major powers of the world still have sizable surface Fleets and continue to build more and better warships."

Guided missiles, the Army man adds, will change the Navy's looks and actions, but surface Fleets are as important as ever. ADM A. A. Burke, USN, the Chief of Naval Operations, agrees that the shape of ships—and of the Navy—will change and tells why:

"The Navy's responsibilities—the things the Navy has to do—have never been greater than they are today. The United States has treaties with friends in almost every important overseas area of the world. I find it difficult to visualize any sea area in the world that we could

afford to abandon to an enemy—even temporarily. In addition to that, the power and range of naval weapons have increased tremendously in recent years. This means the importance to our survival of maintaining tight control of the world's oceans and denying the seas to powerful enemy forces—submarines, aircraft, long-range missile ships—is greater than ever. Nothing is more important to the defense of the United States than control of the seas."

The armada of World War II ships which we have in mothballs or in operation were neither designed nor equipped to meet modern threats to our national security. CNO points out that much of this carrier and ship equipment has only limited usefulness against the weapons which might be employed in a future war.

Admiral Burke adds:

"That is why we are going in for missiles. We are installing missiles in ships just as fast as we can. Yet, we don't want to install them too fast. We don't want to build a lot of expensive missiles at one time and then find out we can get better ones. We don't want to stock up on everything this year and get nothing next

year." So changes in our Navy are being made at a regulated pace, converting several older types while building a prototype for guided missiles or nuclear energy, yet the shape of the Navy is being changed as surely as the contours of a beach are changed by ocean waves. Yesterday's batteries of rifles are slowly making way for SSMs—surface-to-surface missiles which can extend the area of a ship's lethal punch while adding to the accuracy of that punch. Antiaircraft batteries are ready to acknowledge the superiority of SAMs in defending ships and shore installations against air attack. Air-to-air and air-to-surface missiles have proved themselves worthy of installation on the Navy's latest aircraft. *Petrel*, an air-to-surface missile, is ready for operational use along with many other missiles.

What effect are these new armament systems likely to have on our future men-o-war, in their shape and employment? Using the surface-to-air missile as an example, we find a difference of opinion among the experts. Some feel that all our ships should have adequate air defense, so SAMs should be installed on every vessel which can accommodate the

weight and afford the space for guidance equipment, launchers, missile fuels and the missiles themselves; others feel that the Navy should follow the trend toward specialized ships—equip ships to fulfill a primary mission of air defense. Their argument: total use of a cruiser or destroyer type for air defense would be conducive to most efficient use of highly trained guided missile personnel—and more efficient AA fire. Of course, the first group retorts that the best way to lose all your eggs is to put them in one basket.

Medium-range surface-to-surface missiles, because of their size, are not very well fitted for use aboard ships of destroyer type or smaller. The present *Regulus I* is being used aboard aircraft carriers, cruisers and submarines without difficulty. The heavy cruiser *Los Angeles* (CA 135), *Hancock* (CVA 19), and *Tunny* (SSG 282), for example, are capable of using surface-to-surface missiles as well as conventional weapons.

Here it might be noted that Secretary of the Navy Thomas has said that *Forrestal*-class carriers are not prototypes for any new weapons systems, but a "logical step" in the development of a proved weapon. Our present guided missile cruisers with their supersonic anti-aircraft "birds" are a similar step in the development of combatant vessels.

A submarine fitted with missiles can move within target range before surfacing, then rise, fire on a distant target and drop beneath the waves again before the enemy knows what hit him. In comparison with surface vessels, present-day submarines are limited in both speed and capacity—but don't forget *uss Nautilus* (SSN 571). In the words of RADM A. G. Mumma, USN, Chief of Bu-Ships, "she has proved herself so well that the keels for seven other nuclear-powered submarines have already been laid and construction will soon get under way on seven more. These planned submarines include a nuclear-powered guided missile submarine which will combine, for the first time in a single ship, the vastly increased stealth and cruising range provided by nuclear power together with the incredibly destructive force of the Navy's new missiles."

Both the Atlantic and Pacific Fleets now have submarines whose primary mission is the launching and control of guided missiles—but they

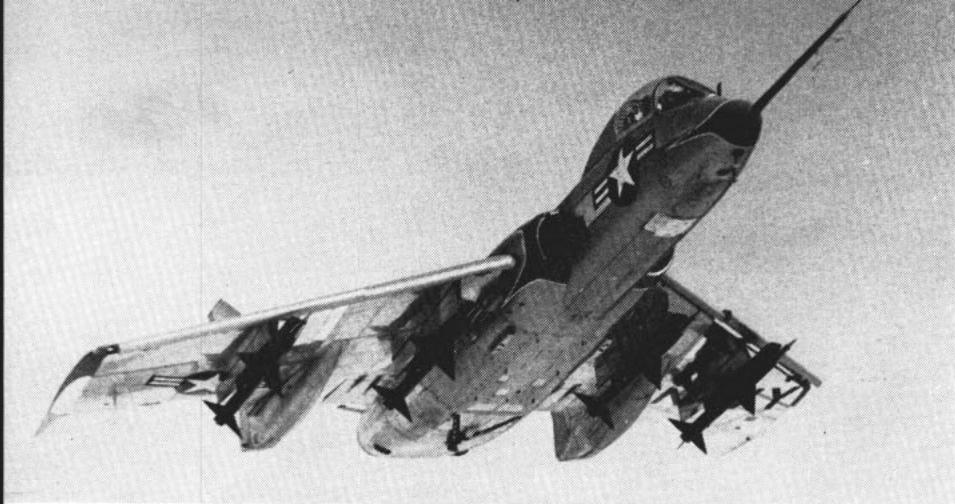
look much like the submarines which depend upon older types of armament. Other standard ship types have long been adapted to this new weapon. The late *uss Mississippi* (AG 128), after long years of service as a "gun platform," gave up her after turret to assume the role of an experimental guided missile launching platform. *uss Norton Sound* (AVM 1) is still serving in a similar role. *uss Boston* (CAG 1) and *Canberra* (CAG 2) will be followed into Fleet service by *uss Galveston* (CLG 93), *Little Rock* (CL 92) and several additional cruisers—each with a silhouette marked by needle-nosed SAMs where once the triple guns of an eight-inch turret symbolized naval might. Other cruisers have retained the after turret, but have been modified to handle *Regulus* missiles. Missile-packing aircraft carriers and destroyers are pulling Fleet duty; while others are being modified or built from scratch.

Guided missiles will be hitched to nuclear power in the first cruiser to be designed and constructed since the end of World War II. Included in the fiscal 1957 shipbuilding pro-



*TERRIER* guided missiles fired from shipboard launchers against enemy aircraft are now operational on Navy ships. Above: air-to-air *Sidewinder*.





**BIRDS FOR THE BIRDS** — Air-to-air guided missile Sparrow now operational with the Fleet is taken aloft under the wings of a carrier based F7U-3M Cutlass.

gram, this CG(N) will be approximately 700 feet long and will be armed almost entirely with guided missiles. According to Admiral Mumma the decision to build a cruiser will permit operational evaluation of nuclear power for surface ships approximately one year earlier than would have been possible with an aircraft carrier. The use of atoms for power will also allow the storage area previously used for fuel to be

used for missile storage or additional fuel for missile-bearing aircraft. Use of this source of power will also permit the elimination of stacks and the introduction of other weight-reducing design efficiencies.

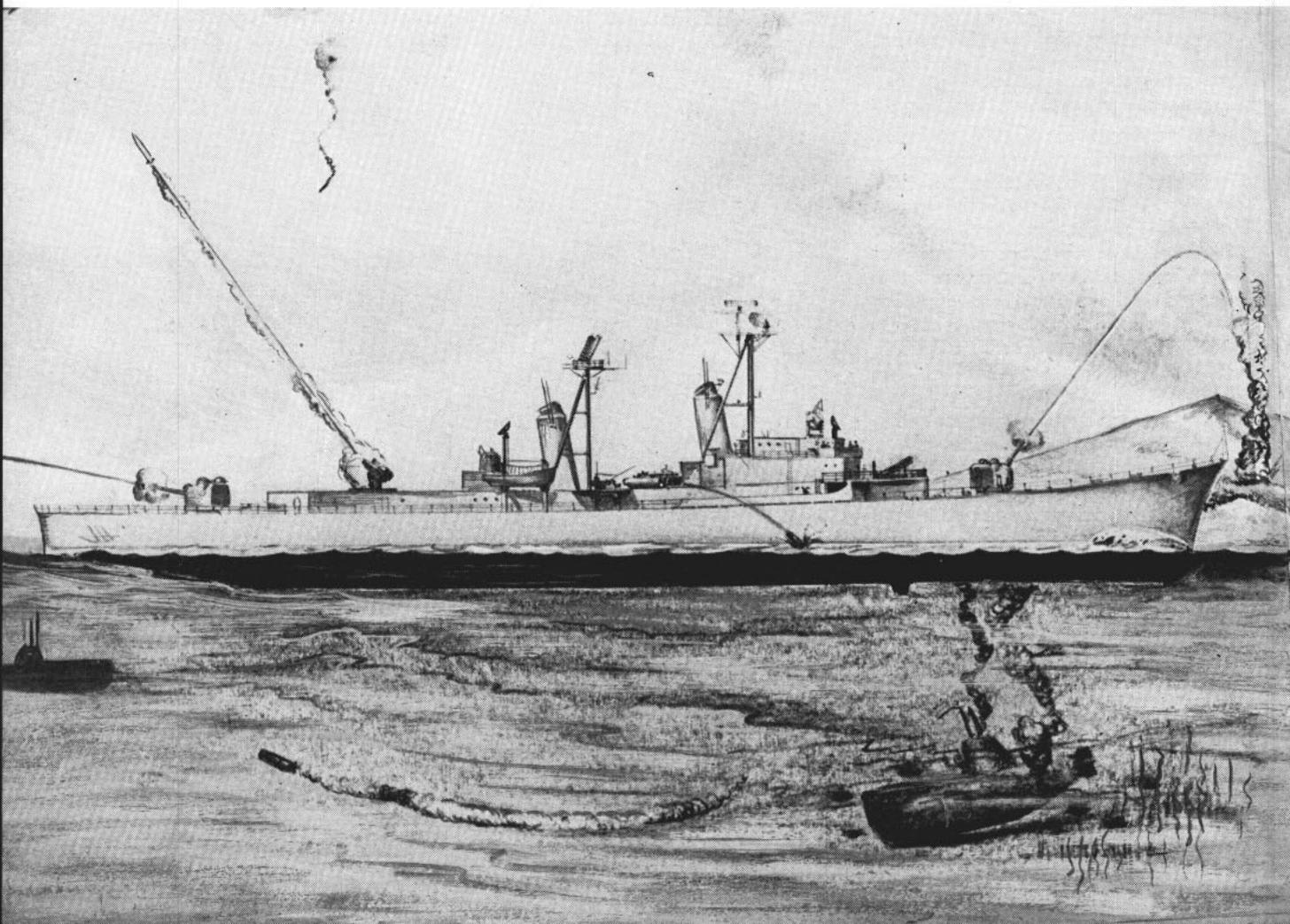
Again according to BuShips' chief, "Nuclear power is producing, and will continue to produce, profound and far-reaching effects upon naval ship construction and Fleet strategy. Nuclear propulsion was first incor-

porated in submarines because it offered greater advantages in undersea craft than in surface ships. Stealth and the ability to launch surprise attacks have been increased because of the virtually unlimited capability to remain submerged for long periods. The *Albacore*-type hull, when applied to nuclear-powered boats, will turn submarines into almost undetectable weapons against which there is almost no defense."

Naval strategy, too, will undergo a change. Shore bombardment, usually considered incidental to a Fleet's main support and protection mission, will be transformed by surface-to-surface missiles. SSMs will extend a ship's striking range far beyond that of the 16-inch gun. The intermediate range ballistic missile which can be fired from shipboard will probably be a great deal more accurate and less expensive than intercontinental ballistic missiles.

The concept of using ships as mobile bases for use in projecting the nation's power into any trouble spot has also come in for fresh em-

**'PUSH BUTTON BATTLE'** in future Navy is depicted by artist showing guided missile destroyer in action.



phasis. It is for such purposes as this that guided missile ships are replacing today's warcraft, and that missiles are replacing guns themselves.

Secretary Thomas recently stated that an arsenal of atomic weapons, air-to-air, air-to-ground, and surface-to-surface, is being fully assimilated. He cautions, however, that "missiles for the foreseeable future are special-purpose weapons. There will be no substitute for the versatility of the small piloted aircraft as a general-purpose weapon for attacking the great variety of fixed and moving, airborne, seaborne, and ground targets within the naval missions. Only the trained pilot on the spot can make the prompt evaluation and decision necessary for selecting targets in a fast-moving situation, or when intelligence is inadequate."

These "special purpose" weapons, despite their advantages, offer a number of problems and hazards as a basic naval weapon. Among these problems and hazards:

- Missile launch and control from a rolling ship platform—a problem which *uss Gyatt* (DDG

712) is helping solve with her stabilizing fins. Some launchers must be stabilized; for a successful launching all of them must grip a missile firmly until the moment of firing.

- Accuracy of fire for a missile-age Navy also demands a more precise navigational system than any now in use, particularly if intermediate range ballistic missiles such as *Polaris* are to be successful. *uss Compass Island* (EAG 153) and another merchant-type vessel have been assigned to work toward a solution of this problem.

- That old devil space remains a problem, since missiles require plenty of room for storage, assembly, testing and launching. Cruisers which have hangars can easily be adapted and smaller types can be converted to handle fairly small SAMs. But SSMs, IRBMs, even some SAMs, range in size and weight from that of a 16-inch shell to that of smaller Navy aircraft. And ships of WW II design are saddled with weight which was necessary when the recoil shock of rifled guns was a consideration, but is in excess

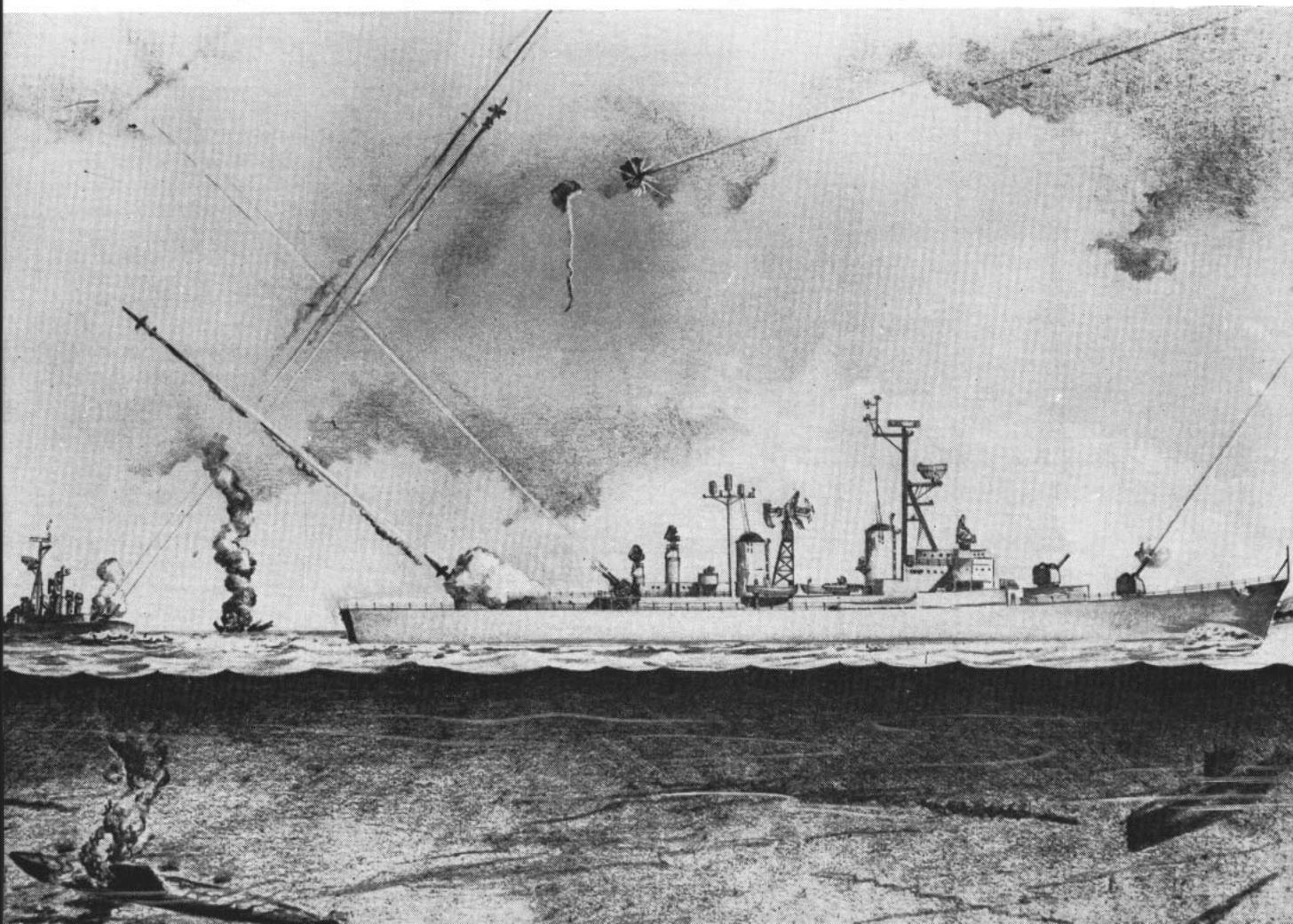
with recoilless missiles. Its presence, however, cuts down on the number of missiles a ship may carry—and on the weight of launching and handling equipment.

Despite *Terrier* and *Tartar*, despite jet fighters armed with guided missiles and rockets, it will be some time before missile systems replace today's anti-aircraft fire systems. Yet Secretary Thomas has pointed out that these missiles have already extended the surface anti-aircraft fire zones through which any attacker must pass, extended them much wider than the few thousand yards they encompassed in World War II.

While the real shape of tomorrow's missile Navy is still on the drawing boards and in the minds of planners, Uncle Sam's sea service began its metamorphosis quite some time ago. Admiral Burke recently explained the situation this way:

"What we are doing right now in this transition period is modernizing and converting all ships. In addition, all the new submarines will have nuclear power—that has paid off. All ships—destroyers and bigger—

FRIGATE CLASS guided missile ship with primary mission to destroy air targets engages the enemy in drawing.



# SHIPS of the GUIDED MISSILE NAVY



**BBG-GUIDED MISSILE CAPITAL SHIP**

Authorized:  
None



**CAG-GUIDED MISSILE HEAVY CRUISER**

Commissioned:  
Boston (CAG 1)  
Canberra (CAG 2)



**CG(N)-NUCLEAR GUIDED MISSILE CRUISER**

Authorized:  
One



**CLG-GUIDED MISSILE LIGHT CRUISER**

Under Conversion:  
Galveston (CLG 93)



**DDG-GUIDED MISSILE DESTROYER**

Commissioned:  
Gyatt (DDG 712)



**DLG-GUIDED MISSILE FRIGATE**

Under Construction:  
Farragut (DLG 6)  
Dewey (DLG 7)  
Macdonough (DLG 8)  
Coontz (DLG 9)  
Authorized:  
DLG 10, 11, 13, 14, 15



**SSG-GUIDED MISSILE SUBMARINE**

Commissioned:  
Tunny (SSG 282)  
Barbero (SSG 317)  
Under Construction:  
Grayback (SSG 574)  
Growler (SSG 577)



**SSG(N)-NUCLEAR GUIDED MISSILE SUBMARINE**

Under Construction:  
Halibut (SSG(N) 587)



**AVM-GUIDED MISSILE SHIP**

Commissioned:  
Norton Sound (AVM 1)

\* Accurate silhouette not shown.

will have a guided missile battery so that they can shoot down planes at 70,000-foot or 80,000-foot altitude—20 miles away. Our electronic equipment has to be very good.

"We have to do the same thing with anti-submarine equipment. We have to get anti-submarine equipment that can detect the submarine at long ranges. We have to be able to identify the submarine at long ranges, and kill him at long ranges before he kills us. It means air-launched anti-submarine missiles, depth charges that will kill submarines at greater ranges, quick ways for finding a submarine from an aircraft or from our own subs.

"We are in a transition period in so many things that we don't want to go all-out in many directions and literally squander billions of dollars. So we are keeping the Navy budget low. Our budget is austere. For example, we have long-range plans where we plan to build a few submarines each year. Each year nuclear-powered submarines should be a little cheaper and a little better. We want to get more guided missiles each year, a few more guided missile ships each year, one aircraft carrier each year—and we hope this year to start our first nuclear powered carrier.

"There are many things that affect plans for our Navy of the future. One of them is the technological progress we are now making. Another big one is dollars. Then, there is a question of what we can do best. We ought to have two or three different arrows in our quiver so that no matter what the enemy tries we can counter him with something effective.

"We develop our weapons as fast as we can, building them primarily on the basis of what we need, but we also take into account what potential enemies are doing. In developing these weapons to defend ourselves, we do two things. We build weapons to defend ourselves against our own capabilities, since we know about our own weapons. We also develop weapons for use against any other capability that other people have been able to devise—our friends, our allies and our possible enemies."

ADM Burke concludes, "We have to be able to meet the threat if war comes, or we will be in big trouble, world-wide."

—Barney Baugh, JO1, USN.



FLYING RATTLER—FJ-4 Fury takes deadly Sidewinder up.

## Airborne Missiles

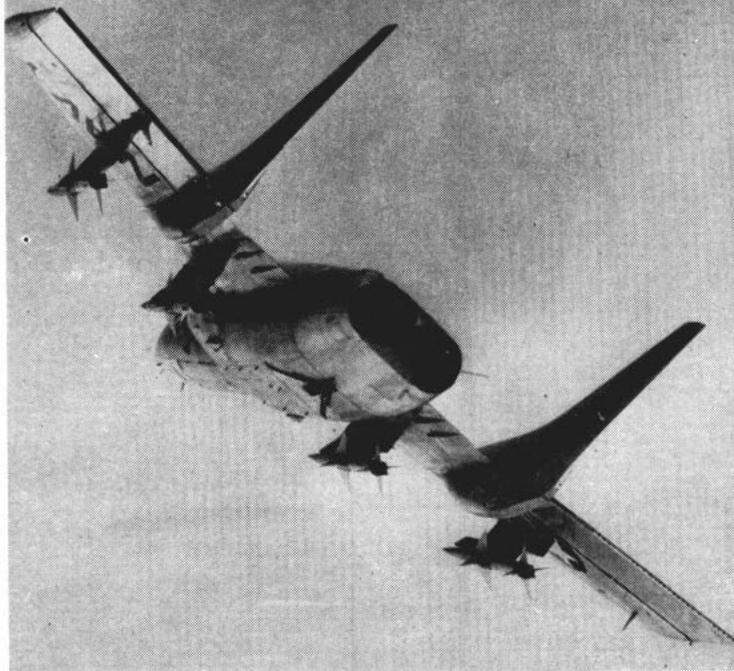
**I**F YOU SHOULD get up in the air about guided missiles and future air warfare, look around and you'll find that a large field of Navy planes has already taken the guided missile airborne over the Fleet.

In case these speedy planes should be traveling too fast for a good look-see, here is a collection of missile-bearing planes that is just a sample of things to come.

Photos represent fighters, interceptors and patrol bombers. Under their wings they will carry air-to-air Sparrow or Sidewinder. Patrol planes like P2V Neptune are being equipped with the Petrel air-to-surface guided missile designated primarily for use against ships. It can be launched well outside the target's air defense and will find its way home in spite of evasive action. All these missiles are operational with the Fleet.



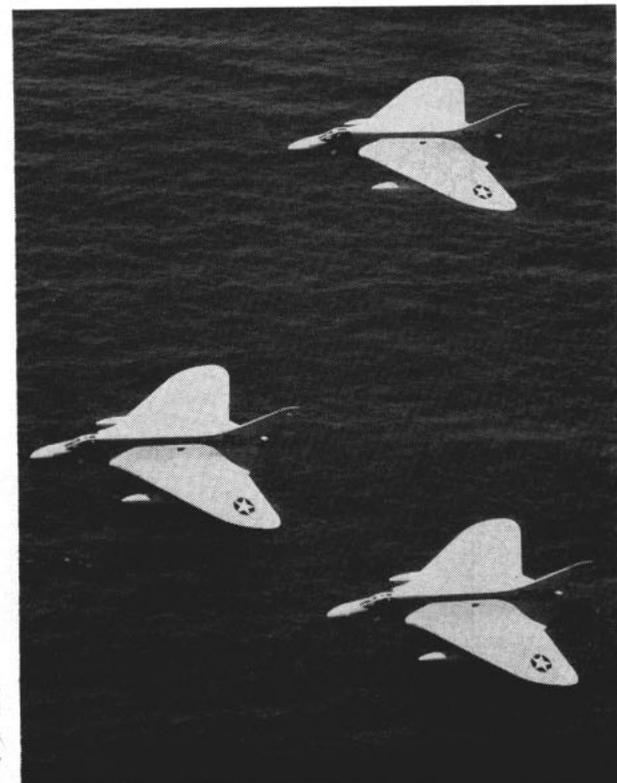
COUGAR JETS, F9F-8s, fly above Fleet with Sidewinder. Below: Twin jet night fighter, F3D Skynight, totes Sparrow.



CUTLASS, F7U, slices through the sky with Sparrow guided missiles nested in launchers under the wings.

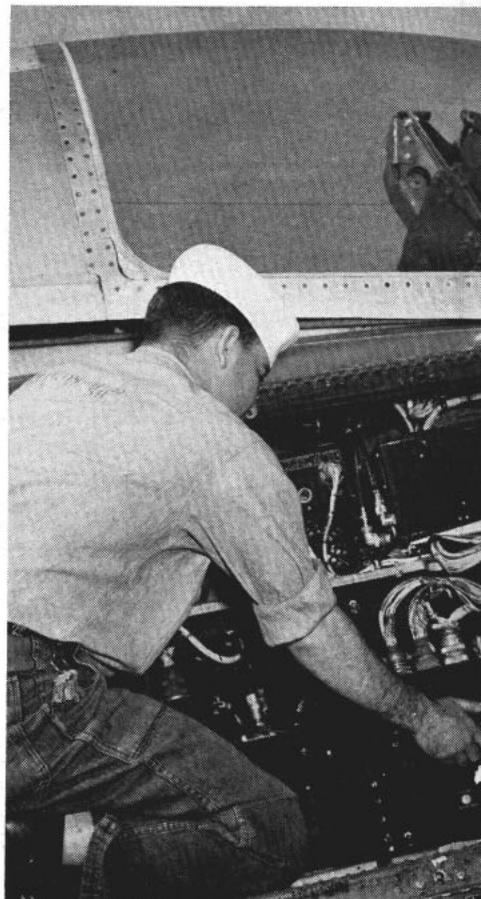


PETREL ON PATROL—P2V Neptune carries air-to-surface guided missiles. Below: F4D Skyrajs will have Sidewinder.





NAVY MISSILEMEN are highly trained sailors stepping into tomorrow's Navy today. Above: Sparrow is loaded by GFs. Below: GSs roll *Regulus* at sea.



GUIDANCE RADAR of *Cutlass* is adjusted.



## New Jobs

"THE NAVY IS JUST NOW crossing the threshold into a field which promises to revolutionize navies as much as did the discovery of gunpowder."

In making that statement, the Secretary of the Navy was referring solely to the field of guided missiles. Although the Honorable Charles S. Thomas made that quote within the past year, it's outdated already. That's because the promise of guided missiles revolutionizing the Navy is no longer a "promise" but a proven fact. If he were to speak about guided missiles in similar words today, he would most likely say that in the field of guided missiles the Navy has crossed a threshold which has not only revolutionized the U.S. Navy, but in years ahead will undoubtedly do likewise for all major navies of the world, as well as all of the branches of the armed forces.

As evidence of this are the many new types of almost unbelievable weapons and ships—and even a

**ALL HANDS**



IT TAKES A LOT of knowledge and skill to get a complex guided missile such as *Sparrow* ready for 'work.'

## For Our Sea-Going 'Missileers'

new-type Navyman—joining the Fleet almost daily.

Today's revolutionized Navy boasts of guided missilemen, guided missile cruisers, destroyers and submarines. Muster rolls already bear a sizable number of missiles either in operation or still in the development stage. They include the surface-to-surface missiles *Regulus I* and *II* and *Polaris*, all capable of being launched from submarines; *Terrier*, *Talos* and *Tartar*, the surface-to-air demons, which will have cruisers and destroyers as their mobile launching platforms; the air-to-surface missile *Petrel* as well as *Sparrow* and *Side-winder*, the air-to-air missiles which are already deployed throughout the world.

Today's revolutionized "missile age" Navy requires a Navyman who is highly motivated as well as educated to assemble, test, adjust, repair and fire these deadly birds.

Without this type of highly specialized Navyman—who must have a thorough understanding of basic

and advanced mathematics, physics, electricity, electronics and related sciences—today's "Navy of tomorrow" would be equipped with impressive but useless weapons. Personnel are even more important in the jet-age Navy than they were in the past.

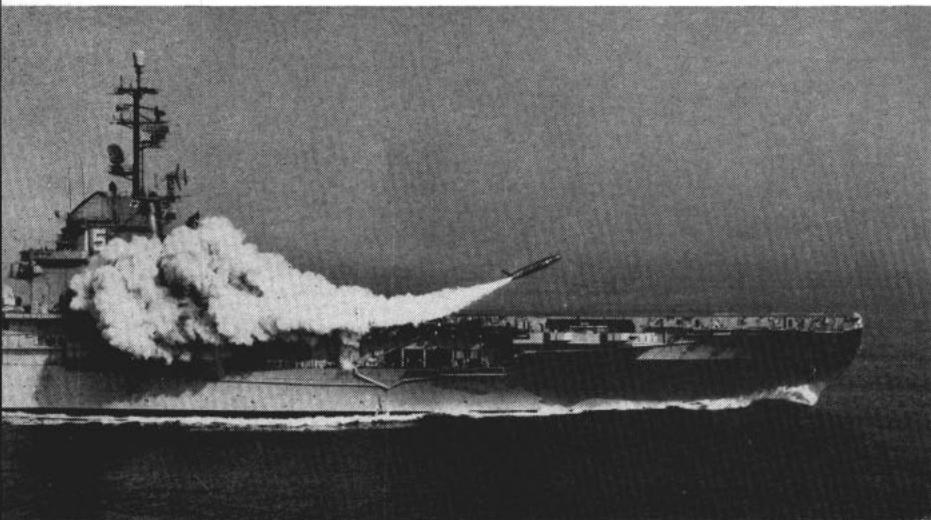
Guided missiles are highly complex weapons. Further, the missiles' testing and maintenance equipment is equally as complex as the missiles themselves. This calls for a well trained core of the operating and maintenance personnel. Accordingly, enlisted men of a very high caliber are being trained more thoroughly in a wider variety of skills than in any other period in the history of sea power.

However, the sailors of today's guided missile Navy are more than just operators and repair men. They're technicians as well. This core of well trained, versatile Navy-men is built around, but not limited to, the **Guided Missileman** (GS) and **Aviation Guided Missileman** (GF)

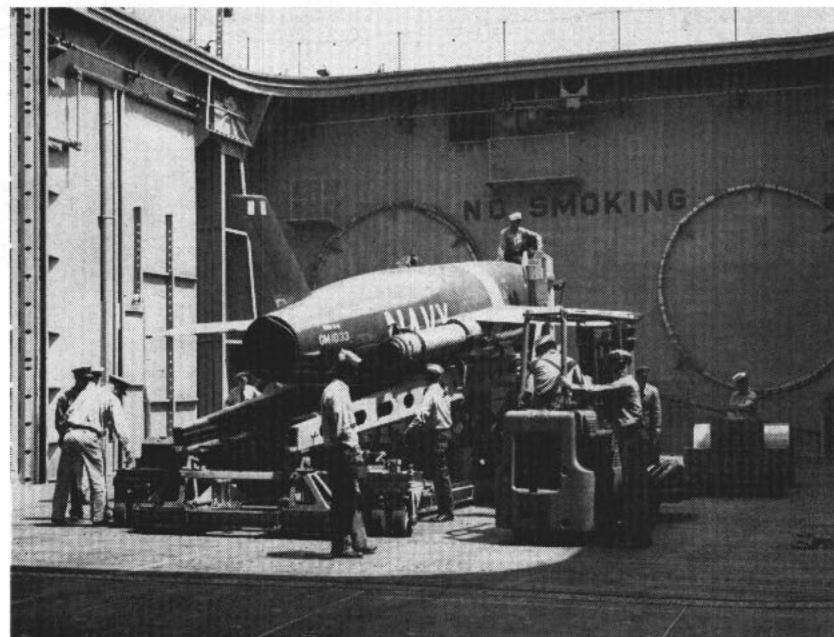
ratings. Although missilemen form the heart of the core, the **Engineman** (EN), **Aviation Machinist's Mate** (AD), **Fire Control Technician** (FT and AQ), **Torpedoman's Mate** (TM), **Gunner's Mate** (GM) and **Aviation Ordnanceman** (AO) are as equally important to guided missile operations.

The duties of GS and GF are perhaps the least understood of all the 60-odd enlisted general service ratings. Very few officers and enlisted men in the Navy, other than those working directly with guided missiles, have an understanding of what a GS or GF actually does. The misconception of these ratings is simply due to the name "guided missileman." Without a doubt, when the average Navyman hears of the GS or GF rating, he instantly visualizes Buck Rogerish types of individuals pushing missiles around, hoisting them aboard launchers and doing nothing more than pushing a button to send them skyward.

Such is far from the case, how-



**ON TARGET**—Missilemen launch *Regulus*, (SSM), guided missile from launcher aboard *USS Randolph* (CVA 15). New type weapon has created new rating.



**MISSILEMEN COMING UP**—Missile and launcher ride elevator to flight deck. Below: Work begins on hangar deck where *Regulus* is rigged for flight.



ever, as these "birdmen," whether GS or GF, are basically concerned with the extremely complex internal guidance and control systems of the missile. This entails a lot of electronics. So much, that the GS and GF are occupied almost on a full-time basis with electronics instead of pushing around missiles, loading and firing them as most people believe. In fact, the missilemen have little or no connection with the more colorful or thrilling Buck Roger's phases of missile operations. Their primary job is to assemble, test, align, adjust and repair all of the missile's internal components. This involves further electronics work, just as the operation and repair of all missile testing equipment does. It all adds up to the GS and GF acting as a specialized electronics technician, who has a tremendous future.

In addition to the internal components of the missile, GSs and GFs supervise the handling and stowage of missile sections and components; maintain work logs and electronic equipment histories; and record test data and prepare reports concerning missile electrical and electronic equipment.

Although the missilemen's primary concern is with the internal guidance and control system, they also have the over-all supervisory responsibility of assembling and replacing all other components of the missile. As you most likely know, these components consist of the air frame, power plant, warhead and fuse, in addition to the missile's guidance and control system.

The airframe is the principal structural component of the missile. The various appendages, such as wings and tail surfaces attached to the airframe, together form the configuration of the missile. These wing and tail surfaces change the course and elevation of the missile in flight and maintain its "flight altitudes." The elevators control pitch, the rudder controls yaw and the ailerons control roll.

These control surfaces take different forms, shapes and positions depending on the type of missile to which they are attached. For example, a subsonic missile like *Regulus I* may have quite conventional wings and tail surfaces. It may be the latest in streamlined weapons. Supersonic missiles like *Terrier* are often more radical in design and use wings resembling

**ALL HANDS**

fins. Supersonic airfoils (wing and tail surfaces) must have a sharp leading (front) edge on the wings whereas the subsonic airfoils have a relatively blunt leading edge. This difference is necessary because of the shock waves that occur in supersonic flight.

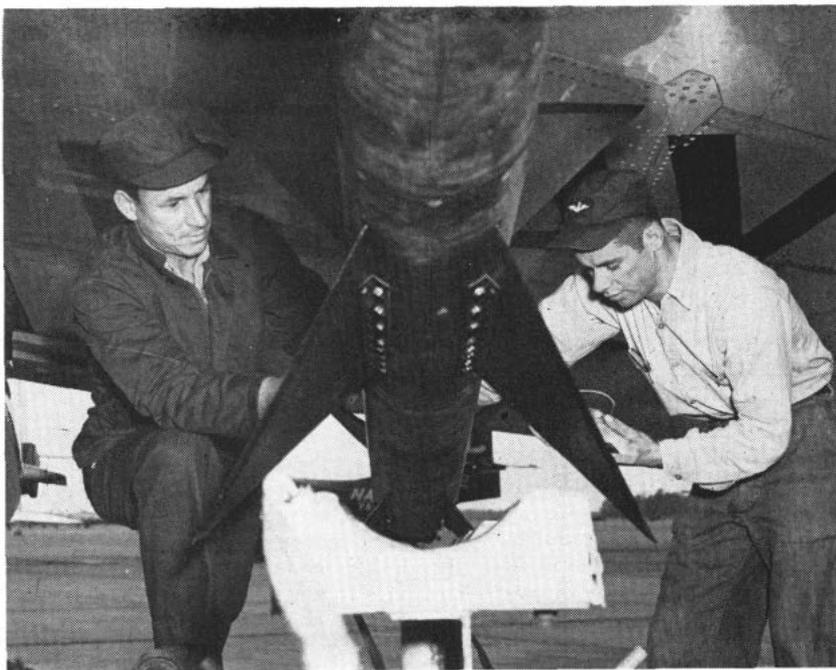
Encased in the airframe and located in the stern of a guided missile is a jet-type power plant, which consists of either a jet or rocket motor. Although there are two separate means of propulsion, both the jet and rocket motors operate on the same principle. Jet propulsion plants are divided into two main classes—mechanical and thermal.

Mechanical jet motors rely on some mechanical device, such as a pump, for the force to accelerate the working fluid to its exhaust velocity. Thermal jet motors rely on heat energy for the force to accelerate the working fluid. The heat energy is supplied by a chemical reaction, usually an oxidation process. Thermal jets have been used extensively in guided missiles and most likely will continue to be used in the future.

A rocket motor is a thermal jet motor that contains within itself all of the elements necessary for a chemical reaction to generate large volumes of high-temperature, high-pressure gases. Its operation is independent of the surrounding medium. Atmospheric thermal jets, on the other hand, utilize the oxygen content of the earth's atmosphere in the chemical reaction which takes place in the combustion chamber. In other words, they do not contain within themselves all of the necessary elements for a chemical reaction. Therefore, they are limited to operation in the earth's atmosphere.

Rockets are classified according to the state of propellant used. The two main classes of rockets are solid-propellant and liquid-propellant. Most Navy guided missiles utilizing rocket motors are of the solid-propellant type.

In addition to the rocket motor, other types of thermal jet motors consist of turbojets, pulse jets and ramjets. Each has operating characteristics which differ rather widely from one another. Because of widely diverse requirements based upon the guidance system, launching system, size and speed of the missile, each type of jet engine has a definite application. Therefore, no one type

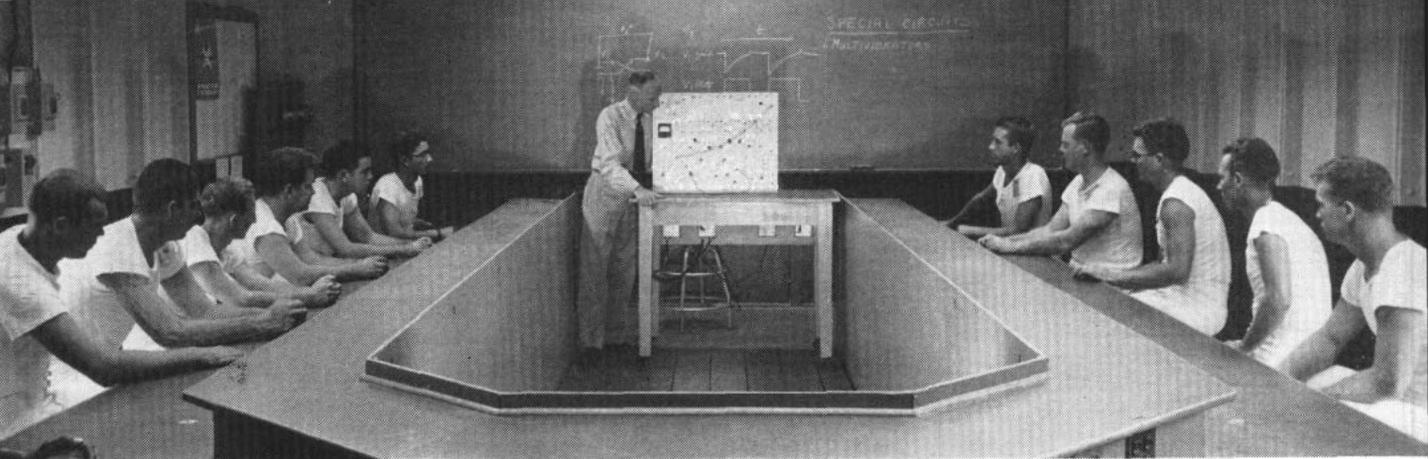


**SPARROW SHOOTERS**—Aviation guided missilemen keep the missiles firing from Navy planes. Here circuit check is made on missile in jet's launcher.



**BIRDMAN'S BIRDMEN**—Air-to-air guided missiles are rolled out to planes and raised to wing launchers of *Cutlass* jets of VA 86 at NAS Oceana, Va.





NEOPHYTE MISSILEMEN — Basic guided missile trainees receive instruction in electronic circuits for guided missiles.

is the ideal guided missile power plant.

The operation, installation and maintenance of the missile's propulsion or power plant does not fall within the scope of the GS or GF ratings. This is where the **Aviation Machinist's Mate** and **Engineman** ratings come into the guided missile picture. The ADs are concerned with the propulsion systems of all missiles while the ENs deal only with the *Regulus* missiles.

The warhead is the missile's payload and the actual reason for the guided missile's existence. The type of target for which the missile is designed is the factor which determines the type of warhead a missile will use. (For a description of the warheads and fuses see page 5.)

The responsibility for installing the explosive components in a missile is shared by **Gunner's Mates**, **Torpedoman's Mates** and **Aviation Ordnancemen**. The GMs and TMs share the surface-to-surface and surface-to-air missiles, while the AD's are in charge of the air-to-air and air-to-surface missiles. **Torpedomen** team up with the AD's to service warheads and fuses in the air-to-underwater missile *Petrel*.

The AOs, GMs and TMs are also responsible for the stowage and shipping of the missiles' warheads, as well as fuses, detonators, boosters and rocket motors. In addition, these ratings usually do the work in connection with setting the missile on its launcher. The launchers are mechanical structures that orient a

missile before firing, and give control to the missile during its initial period of motion. This is done by setting the missile at the proper angle and aiming it in the direction of flight.

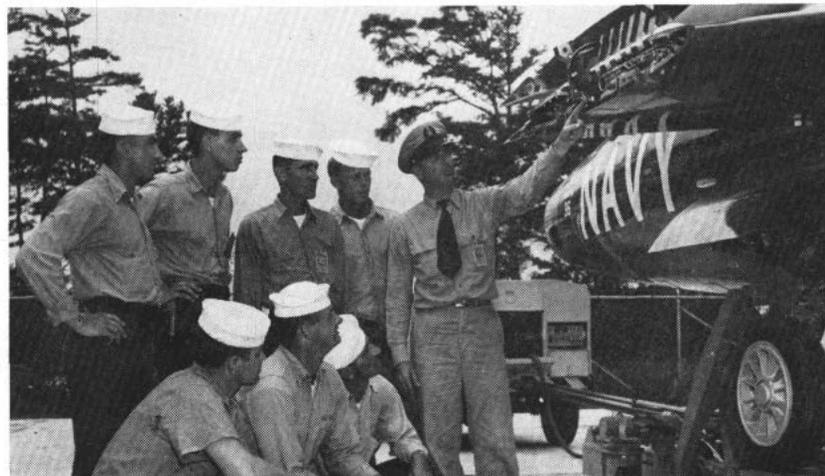
All of which brings us back to the missile's guidance and control systems that have presented problems greater than most in the history of military research and development. These components consist of all the items necessary for predicting the missile's flight path, sensing deviations from this path, calculating the kind and amount of corrections needed to return a new predicted path, translating the corrections into orders, delivering the orders to the control equipment, translating the orders into aerodynamic forces and monitoring the entire system.

Once a guided missile is launched, it comes under the "command" of **Fire Control Technician (FT)** and **Aviation Fire Control Technician (AQ)**. They operate and maintain all of the missile's external control equipment while the GSs and GFs take care of the internal control and guidance systems within the missile.

The two guided missileman ratings are among the newest in the Navy's over-all enlisted rating structure. Establishment of the GS and GF ratings was approved by the Secretary of the Navy on 23 Jan 1953. Five months later, the qualifications for advancement in those ratings and the enlisted classification codes were approved by SecNav. Immediately thereafter steps were implemented for training the "birdmen" of the Navy and provisions were made for personnel of the various electronics ratings to change their ratings to GS or GF. A training program for the conversion of eligible personnel to the guided missileman ratings was inaugurated and



MORE TO MISSILES than meets the eye. Top: Course at NAS Jacksonville passes the word on new *Sidewinder*. Bottom: Students shown *Regulus* missile.



by the end of the first year more than 150 enlisted men had transferred to these new ratings.

Today, the guided missileman conversion and training program is still in effect, but is greatly accelerated to meet increasing requirements. The program includes conversion to AQ and GF, and enables highly motivated enlisted personnel in relatively stagnated ratings to enter the new and expanding guided missile field, and at the same time they are offered an attractive and rapid path of advancement.

At present career enlisted personnel in pay grades E-4 and E-5 of the BM, GM, CS, SH, DC, CD, AB and SD ratings who have a combined GCT-ARI of 110 and a MECH or MK/ELECT of 50 are eligible to apply for the GS, GF and AQ conversion programs. Personnel in pay grade E-4 and E-5 are eligible for GS and AQ, while those in pay grade E-4 only can convert to the GF rating.

Qualified applicants may request to enter any of these conversion programs by submitting a request to the Chief of Naval Personnel in accordance with BuPers Inst. 1440.18.

Personnel selected for the GS conversion program will be assigned to a 20-week course in basic electronics at the U.S. Naval Schools Command, Treasure Island, San Francisco, Calif., and then to a 12-week missile course at either Dam Neck, Va., Pomona, Calif., or Mishiwaka, Ind. After completing both phases of the conversion training, graduates have their rating changed to GS.

Personnel selected for conversion to AQ or GF will be assigned to NATTC Norman, Oklahoma, for four weeks of Electronics fundamentals training, then to NATTC Memphis, for the AQ or GF training as applicable for a period of 24 weeks. Upon successful completion of these phases, ratings will be changed to AQ or GF as appropriate.

In addition to the schooling given as part of the conversion program, the Navy maintains approximately 10 different schools for training the officers and enlisted personnel earmarked for surface launched guided missiles. (A list of these schools can be found on page 50.)

Upon completion of training, the Navy missileman may be retained for instructor duty at one of the schools or be assigned to a guided missile ship, unit, group, research

and development site or guided missile service installation.

As you have already seen, the guided missile ships currently in operation include the guided missile experiment ship *uss Norton Sound* (AVM 1), the guided missile submarines *uss Tunny* (SSG 282) and *uss Barbero* (SSG 317); the guided missile cruisers *uss Boston* (CAG 1) and *uss Canberra* (CAG 2); and the guided missile destroyer *uss Gyatt* (DDG 712). Also playing an important role is the miscellaneous experimental ship *uss Compass Island* (EAG 153).

In addition to these ships which are specifically designated as guided missile ships, GS, GF and other ratings that work with the various components of a missile can be found serving aboard aircraft carriers and a number of cruisers with guided missile capabilities.

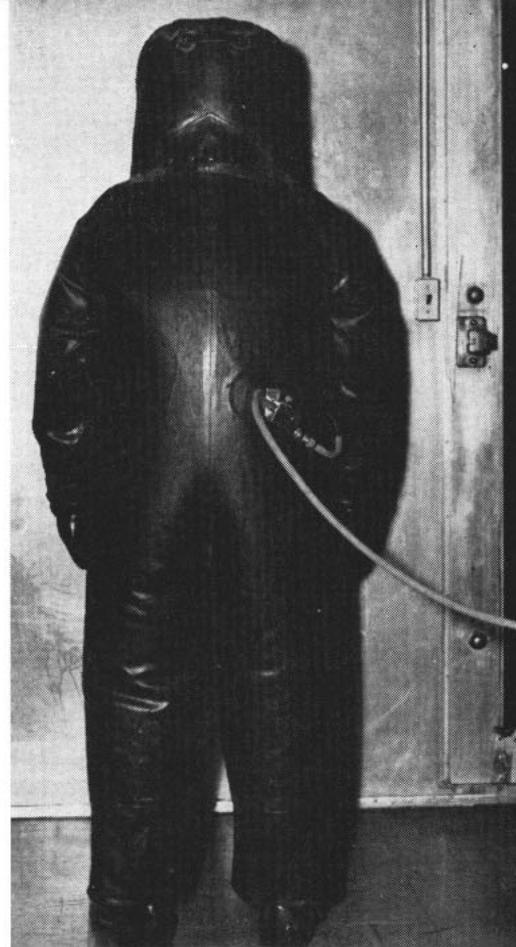
At present the Navy maintains two Guided Missile Groups—one on the East and one on the West Coast. These groups provide mobile teams which move aboard cruisers and carriers as well as other ships capable of handling guided missiles. They move aboard lock, stock and barrel, complete with their missiles, test equipment and launching racks, much in the same manner as helicopter and drone units operate.

The East Coast-based group normally calls Chincoteague, Va., home while the West Coast-based group is split up. Half of the group is based at Point Mugu, Calif., while the other half is located at NAS Barber's Point, Oahu, T.H.

Supplementing the two guided missile groups are two Guided Missile Units. They are GMU 50 and 51 which handle the *Regulus* missiles for the Navy's underwater arm. GMU 50 is based at Port Hueneme, Calif., while GMU 51 services SubLant's guided missile units from its Yorktown, Va., base.

The various research and operational development sites where you will find missilemen and related ratings attached are listed on page 30. They are also quite often assigned to guided missile service support units which provide logistic support to the Navy's operating guided missile ships, groups and units. At present there are seven of these support units. They are located at Hingham, Mass.; Yorktown and Oceana, Va.; Charleston, S. C.; Crane, Ind.; and Seal Beach and Miramar, Calif.

—H. George Baker, JOC, USN



SPECIAL GEAR—Suits protect Navy-men from potent missile fuels. Hose gives air for ventilation and breathing.



# The Zooming History of Navy's

THERE'S NOT A PERSON in the world who can lay claim to having invented the guided missile. It is an instrument of warfare that just "came about" in stages, then suddenly achieved a state of development where it promised a potential far beyond that of other types of missiles. Years of work in the chemistry labs, engineering shops, on the drafting boards, by mathematicians, and countless of other professionals, have combined to give us the guided missile.

Like mountain streams growing into rivers and feeding the oceans, the guided missile has evolved from

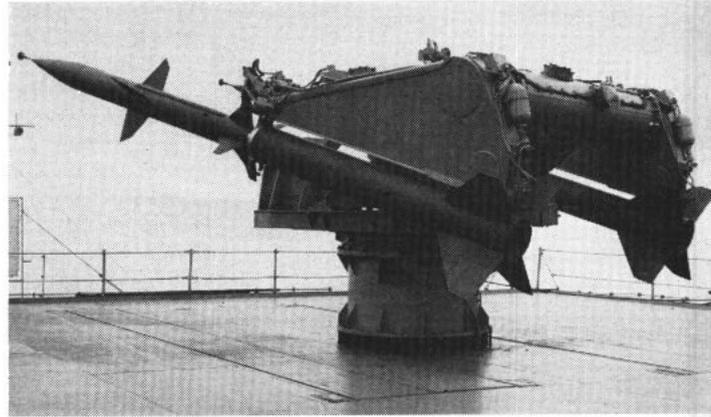
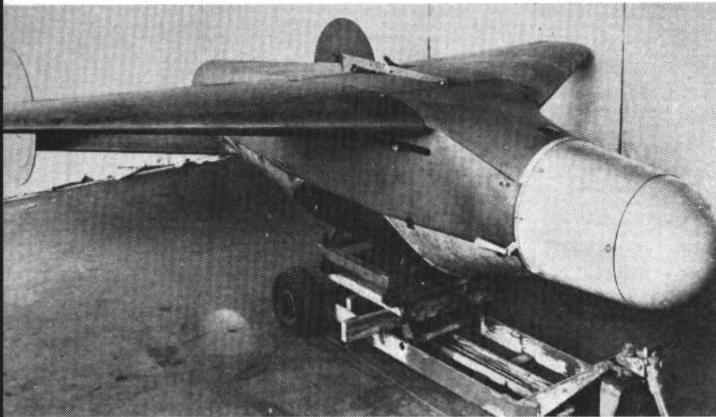
et, and the *manned aircraft*. Certain of today's medium and long-ranged guided missiles show clearly the predominant influence of the latter ancestor, and these have been called pilotless aircraft.

However, a much larger number, including some large and many small guided missiles are much more closely related to the artillery rocket than to the airplane. In some cases the two original types of characteristics have been so interwoven as to produce a new combination in which it is quite difficult to say which of the two original ancestors have the predominating influence.

zation. These principles are still in use today in the development of guided missiles.

The Navy itself has been in the business of guided missiles for quite some time, although you may not have realized it. As early as World War I, the U.S. Navy had developed another "world's first" guided missile. Although successfully tested, the Navy's "aerial torpedo" became lost in the secrecy of World War I and was never used against the enemy.

This guided missile was described as "... an automatic aerial torpedo, a passengerless aeroplane, capable



a vast flow of basic research in widely divergent fields, each independent and probably unknown to one another. When these streams of research were all put together, they provided the essentials of today's guided missile.

If you want to go all the way back in history, you might say that missiles, as such, came into being during the days of the cavemen. Caveman Hatfield aimed a rock at Caveman McCoy. Loosely speaking, that rock was one of the predecessors of the guided missile.

But up to the fairly recent past all missiles—like that rock—had one major deficiency—they did not always hit the intended target. The solution to this is really quite simple: alter the path of the missile while it's in flight so that it will strike what you want. This proved to be much easier said than done.

The guided missile, as we know it today, can be thought of generally as descending from two original forebears, the *ballistic* or *artillery rock-*

A third type of missile, the *torpedo*, developed during the Civil War, is classified by many as the world's first guided missile. It was during this time that the gyroscope was used in an attempt to control that torpedo, but the gyros available at that time were so inaccurate that all attempts failed. But who is to deny the fact that the sound-homing torpedo of World War II is not a true guided missile?

The rocket, more closely associated in the mind of the general public as one of the forerunners of today's guided missile, has been in use since before the days of Wan Hu in the fifteenth century. (see box, page 58). Rockets brought home the fact that unless man found a way to guide them, he would never be able to utilize fully their high speed and long range.

But it was only in the early 1900s that Dr. Robert H. Goddard, of Clark University in Worcester, Mass., set down the principles of rocketry, including the problems of stabili-

of flying a desired distance on a course, true and predetermined, and of descending to earth and exploding a heavy charge upon impact. . . . Research, development and field tests of these "passengerless aeroplanes" — which were radio-controlled and looked like a biplane — were carried out at a secret airfield on Long Island. Approximately 100 of these early missiles were fired out into the Atlantic Ocean and a good number of direct hits were made on targets up to 96 miles away. They carried 1000 pounds of TNT.

Research in the field of guided missiles continued slowly after the end of WW I because of a lack of interest, lack of funds, and the primitive state of electronics.

In the 1920s BuAer was experimenting with radio-controlled aircraft. These early experiments, however, were conducted under the greatest of disadvantages: not only the lack of funds, but poor instrumentation facilities, lack of space, and hazards to their personnel.

# Missiles

Despite this, it was around 1923 when the first drone (an unmanned airborne vehicle) was successfully flown at the Naval Proving Grounds, Dahlgren, Va. This early effort led to the development of the target drone for anti-aircraft practice. A logical next step would be to add bomb loads to the drones and drive them into enemy targets. (This was done in World War II when assault drones played their first role in combat.)

During the '30s, the majority of the research work in the field was performed by American and German civilian rocket societies. The exchange of information and research data between these groups greatly aided the ushering in of the guided missile era.

It is the Germans who are credited with launching the first actual guided missile attack during wartime. In August 1943, a British convoy was steaming through the Bay of Biscay, vigilant for enemy submarines and aircraft. The lookout on one of the ships saw what appeared to be a small fighter come out of a turn directly toward the ship at incredible speed. Anti-aircraft guns were quickly brought to bear on it but because of the object's small size and tremendous speed, the guns were ineffective against it.

As it approached close to the ship, this "aircraft" which the lookout had spotted didn't pull out of the dive in the familiar dive-bomber fashion but continued on its course until it hit the ship and exploded.

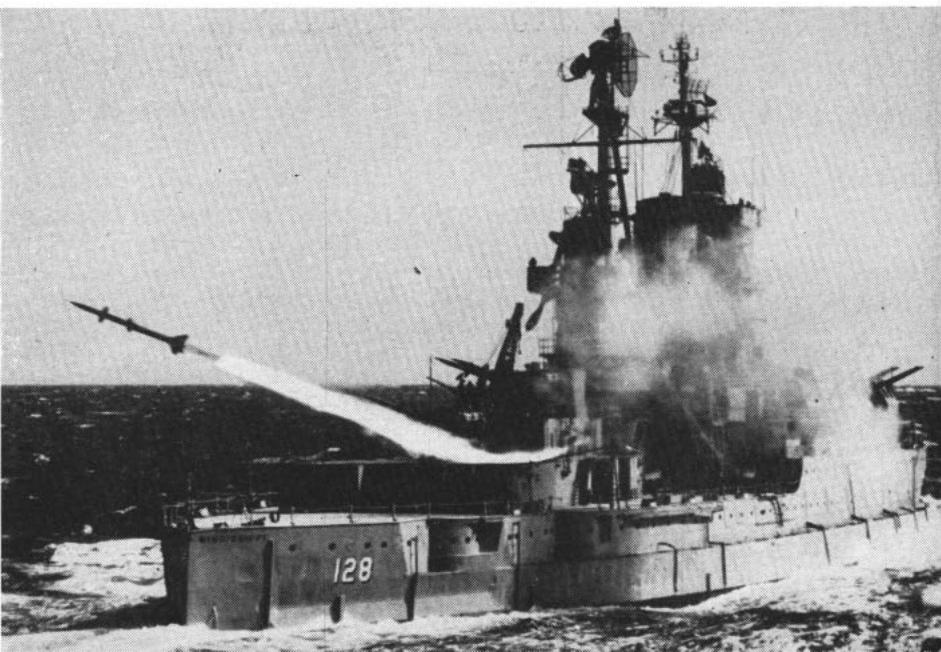
It had been too small to carry a pilot and it had no visible means of propulsion. It executed a turn and unerringly attacked its target. Later, it was learned that this was actually a radio-controlled guide bomb, launched and controlled from a German airplane.

This incident is said to have marked the opening of modern guided missile warfare. Here, in the Bay of Biscay—less than a decade and a half ago—for the first time in the history of warfare, a radio-controlled guided missile was used.

Navy experimentation with drones of the 1920s was also to be demonstrated in battle during World War II. The Bureau of Aeronautics produced a unit in 1943 and called it



ON TARGET — *Bat*, guided glide bomb of WW II, heads for target ship. Center: *Regulus* tested in ship-board launching. Below: *USS Mississippi* (EAG 128), whose last service to Fleet was testing missiles, fires *Terrier* from stern.



an "assault drone." The news of the job the drone did against the enemy was lost in the welter of wartime headlines.

These drones, or "guided missiles" if you will, were launched against Japanese installations at Rabaul in 1943 with fairly good results, considering their infant stage of development at the time. Named the "TDR," each drone was controlled by the command system from a parent aircraft and each carried a television unit. A receiver in the mother plane showed the operator what his missile was pointing at until the final moment of impact.

At the same time the U.S. Navy was working on the *Bat*, said to be the first *fully automatic* guided missile to be used successfully in combat by any nation. It was launched from Navy planes and directed by radar to targets miles away. It destroyed many tons of Japanese combatant and merchant shipping during the last year of the war.

This missile was a low-angle-of-flight, self-contained, airborne hom-

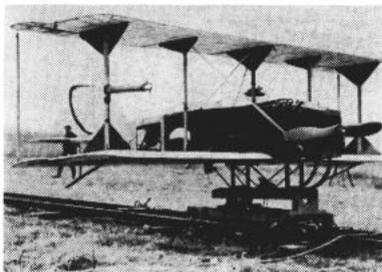
ing missile. It carried a bomb mounted in a glider type of air frame which was equipped with a radar transmitter and receiver to give directional correction, and a gyroscope stabilizing unit. It also had a servomechanism to move the control surface on the wing. The complete unit was suspended beneath a wing or the fuselage of the parent plane.

The idea for the *Bat* missile had come about in early 1942 at a conference between scientists and technicians from BuOrd and the men at

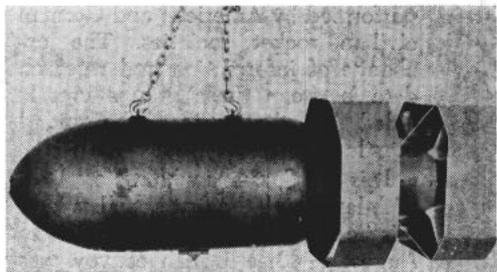
the Radiation Laboratory at the Massachusetts Institute of Technology. The theme of the meeting had been the "bombing through overcast" problem. At this conference, Dr. David Briggs made a suggestion concerning the possibility of using radar systems in connection with a glide bomb. Research had been underway for some time on such newly discovered principles as radar homing, aerodynamics and control of glide bombs. Combining these various discoveries ended in

## Picture Story of How the Navy Guided

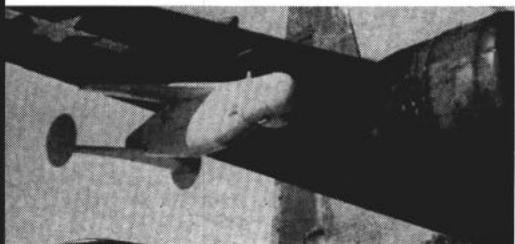
WW I Aerial Torpedo



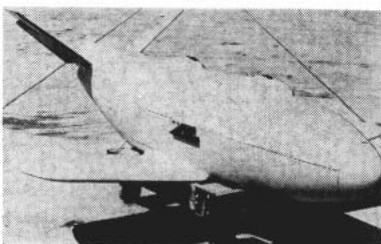
Razon (Guided Bomb)



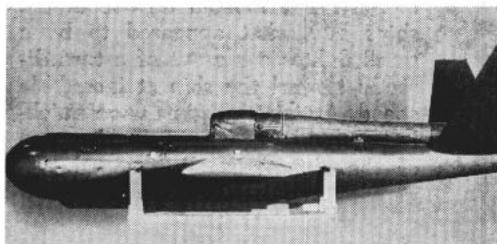
Bat



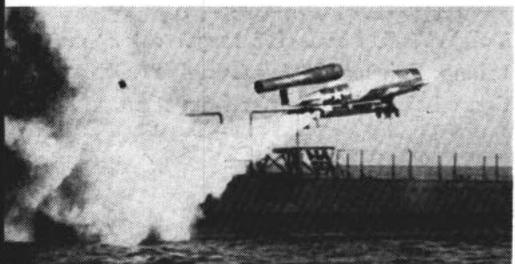
Gargoyle



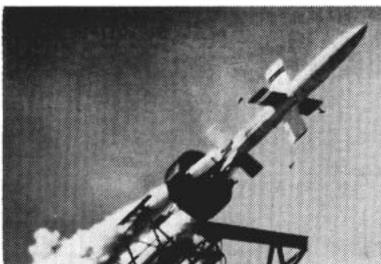
Katydid



Loon



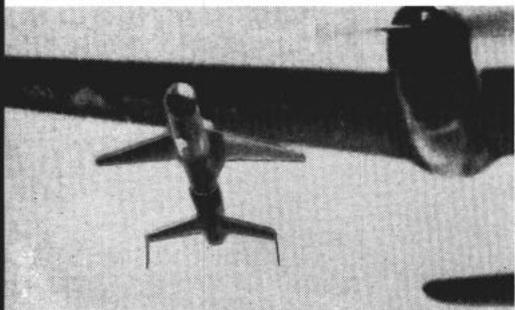
Lark



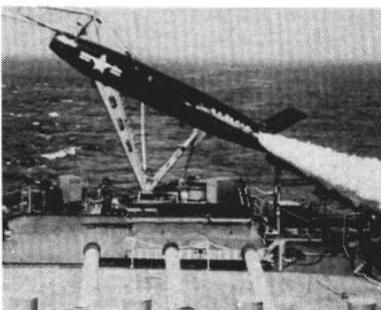
Firebee



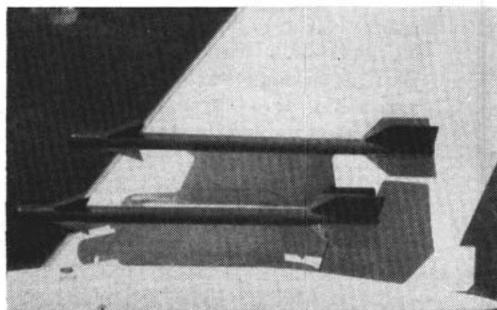
Petrel



Regulus



Sidewinder



the production and use of Navy's *Bat*.

The production of the *Bat* was a fine example of the cooperation necessary then and carried on to an even greater degree later to produce today's guided missiles.

Just about every major bureau in the Navy has a part in the guided missile program. BuOrd and BuAer are primarily concerned with missiles development. BuShips is concerned in launching and installation problems. BuPers has the job of training the personnel. The Office

of Naval Research coordinates efforts in basic research and finally, the whole program is operationally coordinated by the Director, Guided Missiles Division, under DCNO for Air. To go even a step further, on the Department of Defense level, the research and development of guided missiles by all three services is coordinated by a Special Assistant to the Secretary of Defense for Guided Missiles.

The photos on these pages tell pictorially the history of guided

missiles in recent years. One of the first basic research programs started by the Navy was the Bumblebee project. Some of the more outstanding missiles to come from that program were *Terrier* the surface-to-air anti-aircraft missile now in operational use, and *Talos*, another surface-to-Air AA missile.

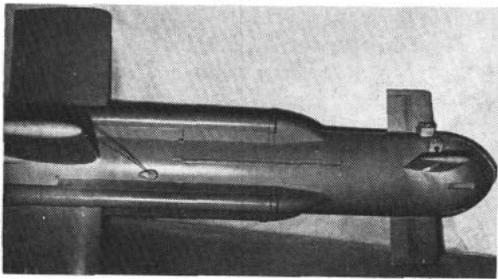
And to give you an idea of where these projects can lead, *Bumblebee* project also produced the ram-jet engine, the "flying stovepipe" with a speed greater than 1500 mph. Technical direction of the *Bumblebee* project was under the Applied Physics Laboratory of John Hopkins University. Included in the program were some 20 other agencies.

Of course, no single outfit is completely responsible for developing any guided missile. Private and government laboratories, universities, industry, contract scientific groups and Army, Navy and Air Force test ranges have duties which vary from pure research to mechanical engineering.

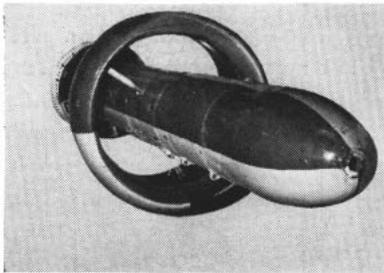
As you can see, the basis for most

## Missile Developed Its Present Shape

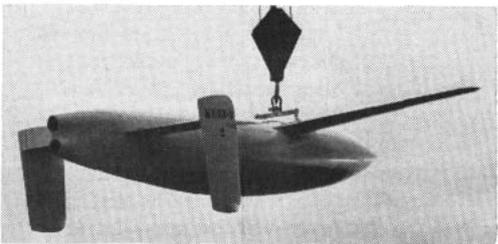
*Little Joe*



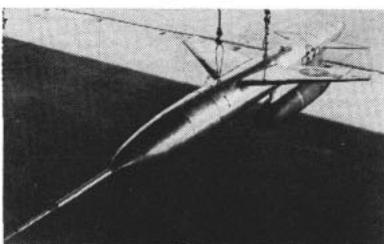
ROC



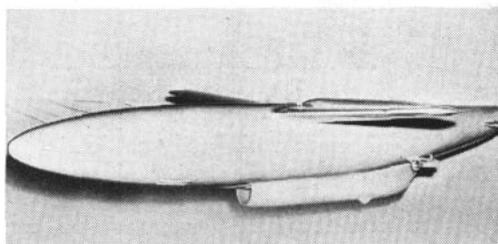
*Gorgon (KU3N-2)*



*Early Gorgon*



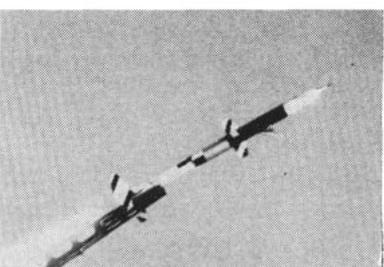
*TD2N-1*



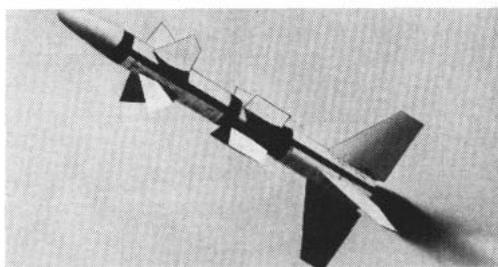
*Drone (Hellcat F6F)*



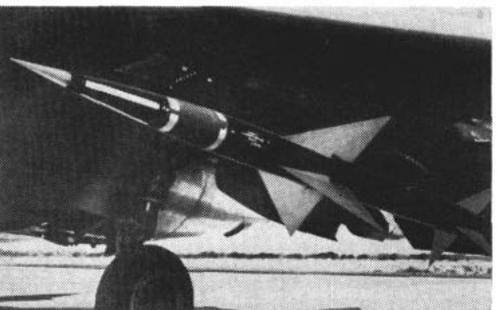
*Rigel*



*Talos*



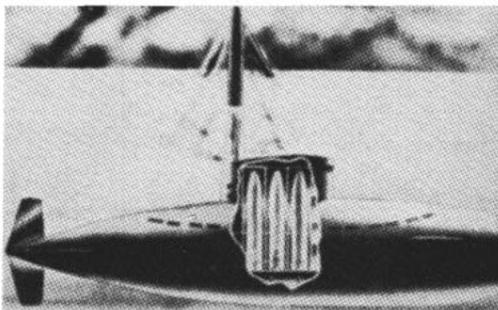
*Sparrow*

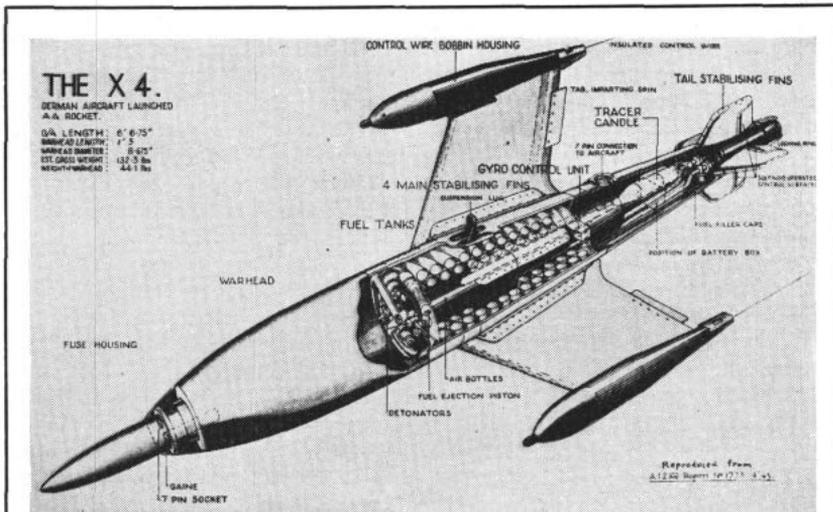


*Terrier*



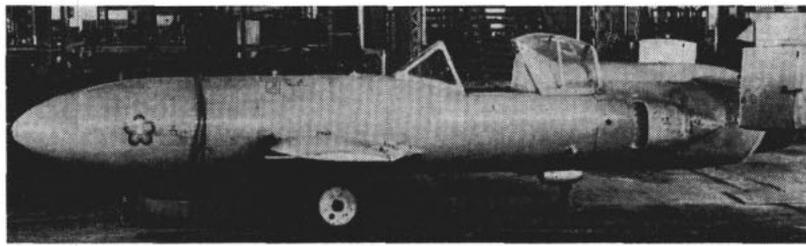
*Polaris*





**THE X 4.**  
 GERMAN AIRCRAFT LAUNCHED  
 A.A. ROCKET.  
 O.A. LENGTH: 6' 8-75"  
 WARHEAD LENGTH: 1' 5"  
 WARHEAD DIAMETER: 3-02"  
 EST. LAUNCH WEIGHT: 132-3 lbs  
 WEIGHT/WARHEAD: 44-1 lbs

AXIS EFFORTS in missile field during WW II had great influence on missile development in U.S. Above: Nazi air-to-air guided missile designed to down Allied bombers had just gone into production when war ended. Below: Baka 22, Japanese suicide bomb used on ships, guided by pilot.

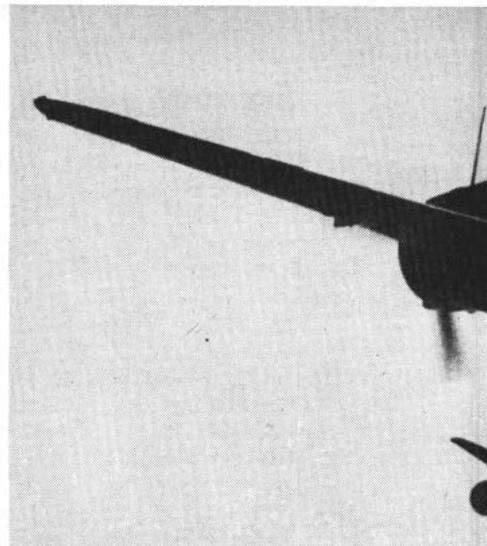
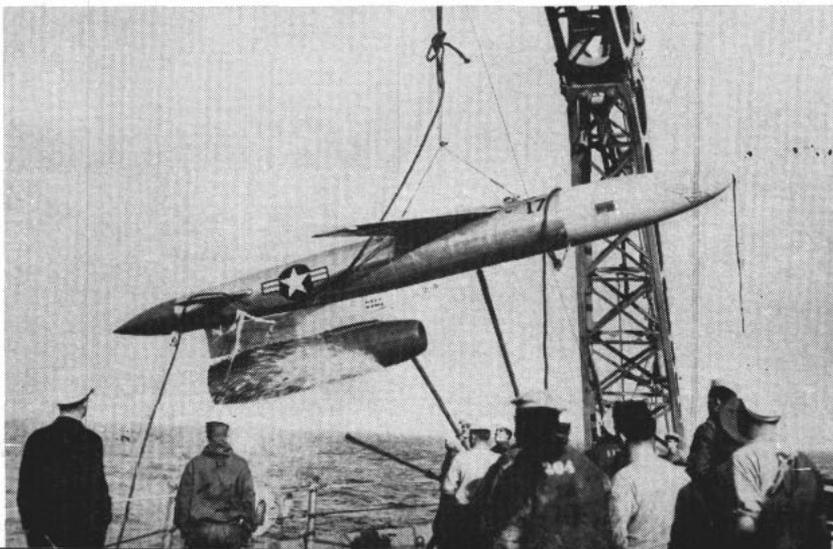


of the work and production in guided missiles is research. A prominent physicist, who has worked with guided missiles for many years, compiled an offhand list showing that missiles development involves research problems in such fields as aerodynamics, combustion, propellants, gyros, servo-mechanisms, radar, electronic components, radiowave propagation, telemetering, proximity

fuses, shaped charges, warhead fragmentation and damage probability, upper-air combustion and interplanetary navigation.

Research and development in guided missiles sustained its momentum after the close of World War II since efforts up to then clearly indicated that only the surface of this vast field had been scratched. Late in World War II,

**GORGON IV** experimental guided missile is hauled back on board mother ship after flight during studies of ram-jet engines used as missile power plants.



WW II BAT bomb breaks away from SBS2

Point Mugu, some 60 miles north of Los Angeles, was established as the Navy's Air Missile Test Center (see page 34). This was one of the first guided missile test and evaluation centers ever established.

The earliest missile project undertaken by this station was testing of the KUV-1 *Loon*. This was the Navy version of the well-known German missile V-1 or buzz bomb. The German models of the V-1 were not true guided missiles since they flew a pre-set course which could not be altered after launching. The versions tested at Pt. Mugu incorporated radar and radio guidance.

Other early missiles with which the Pilotless Aircraft Unit (as it was then called) worked included *Little Joe*, *Gorgon* and *Gargoyle*. *Little Joe* and *Gargoyle* were pioneering efforts in the missile field and never did reach the operational stage. However the glide bomb *Bat*, a successor to *Gargoyle*, was put into operation in the latter months of WW II.

*Gorgon* was another development of the *Gargoyle* but incorporated a jet engine for propulsion and television for guidance. This missile is believed to have been the first of the more modern type of air-to-air missiles typified today by missiles of the *Sparrow* family.

*Little Joe* was designed for launching from land or shipboard sites against aircraft. It was developed primarily for use against the Japanese kamikaze and baka bombs but never did see action.

Other missile projects in which NAMTC has played a role include *Lark* and *Regulus*. *Lark* project was concluded in 1952 and *Regulus* is now in operation.



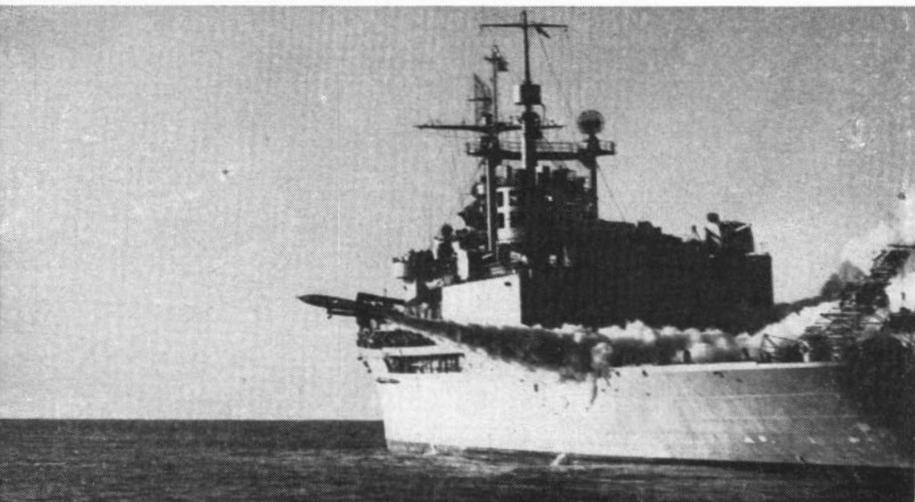
to send an enemy ship to its watery grave.

Some miles to the east of Mugu is another vitally important Navy activity, the Naval Ordnance Test Station, Inyokern, Calif., better known as China Lake. The scientists and engineers here have been working for years, testing, evaluating and developing rockets of all sorts.

One of the results of their work has been the development of a five-inch rocket with a small guidance unit. Since this air-to-air missile was born in the desert and is quite deadly, it was named *Sidewinder*.

Many other "firsts" in missile development are credited to the Navy. As Rear Admiral James S. Russell, USN, Chief of BuAer, recently pointed out, "The *Lark* was the first surface-to-air missile known to have destroyed a target aircraft; the *Sparrow I* was the first all-weather air-to-air missile system to become operational; and the *Regulus I* was the first ship-launched, surface-to-

**PIONEER MISSILE SHIP** — *USS Norton Sound (AVM 1)* is a veteran among Navy's missile ships. Here, she launches the *Loon* in early missile tests.

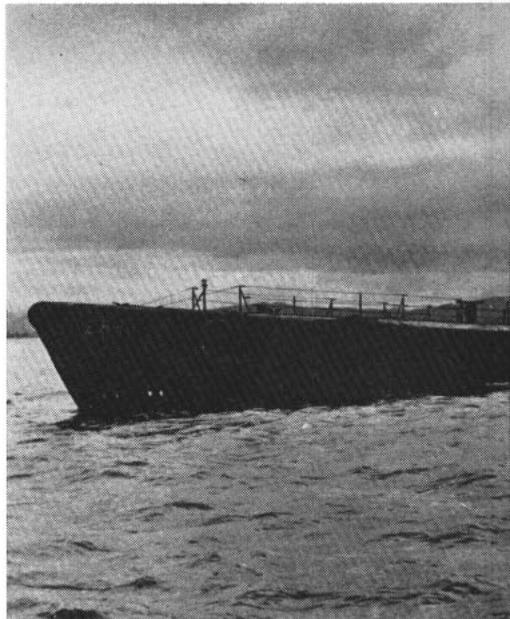
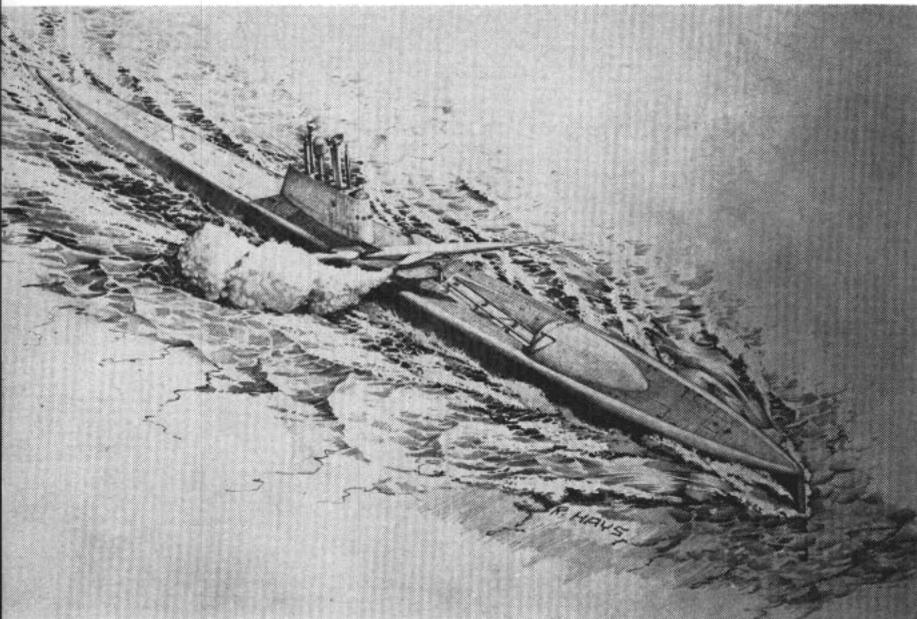


'EARLY BIRDS' — Navymen attach an air-to-surface guided missile to parent plane in 1946 experiments. Below: *Loon* missile is tested in JATO take-off.

surface missile to become operational."

Another "first" has also been reached. The Navy, along with the other services, has taken its first steps into the vast, unexplored ocean of the atomic and guided missile age. The origin of the guided missile may be difficult to pinpoint, but like the stream turned into river and pouring into oceans, the years of research and study in so many and varied subjects has given the world its first true guided missiles, and very possibly, in our lifetime, interplanetary travel. —Rudy C. Garcia, JOC, USN.





## Davy Jones' Locker Stocks

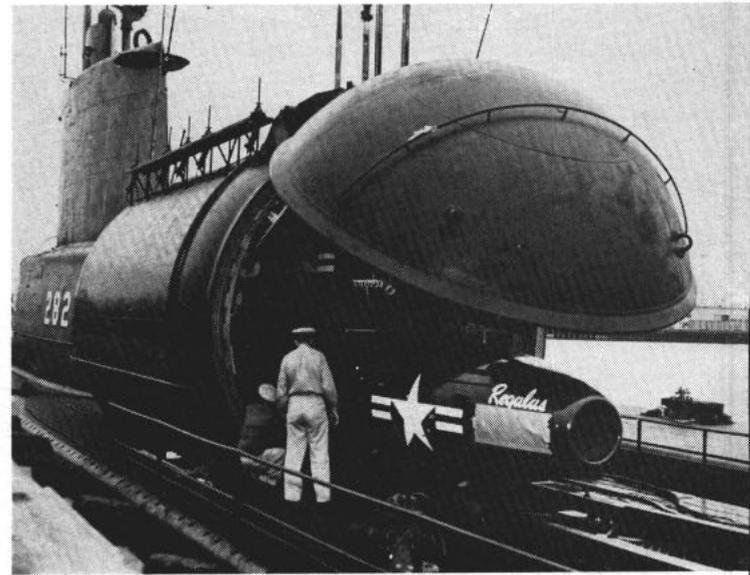
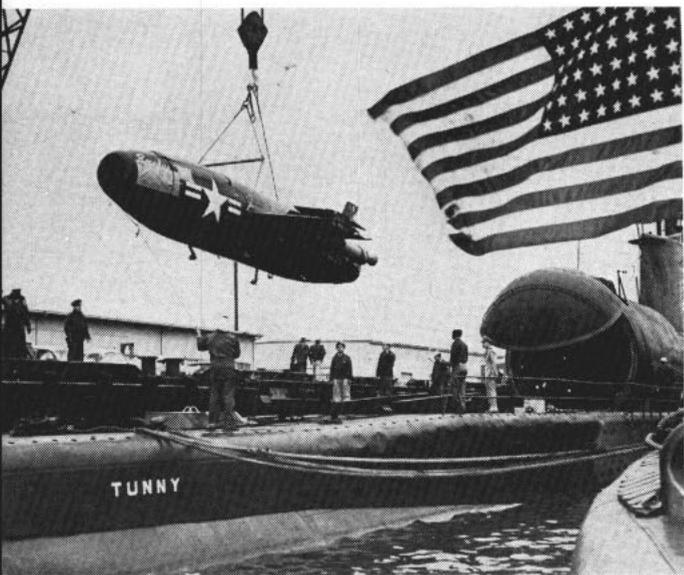
THINGS HAVE BEEN happening down in the realm of Davy Jones that have caused him to sit up and take notice. It was bad enough (he thought) when Navymen began to sail through his domain in large "tin fish" but now Davy's sense of security is "shook" to its roots by the sight of atomic powered and guided missile submarines slicing through his watery world.

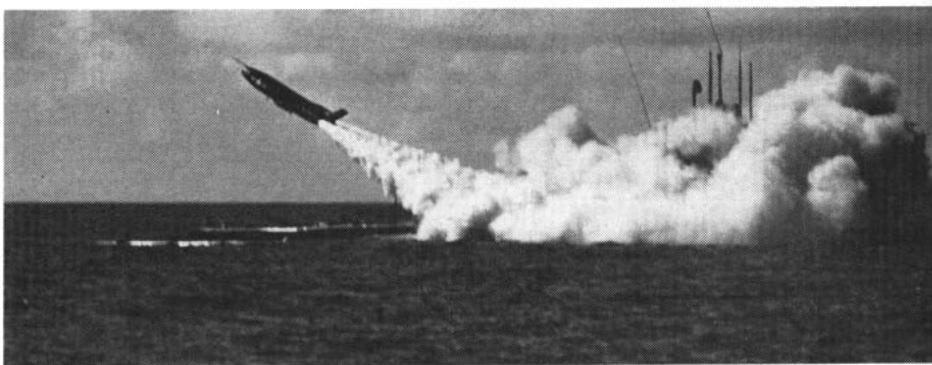
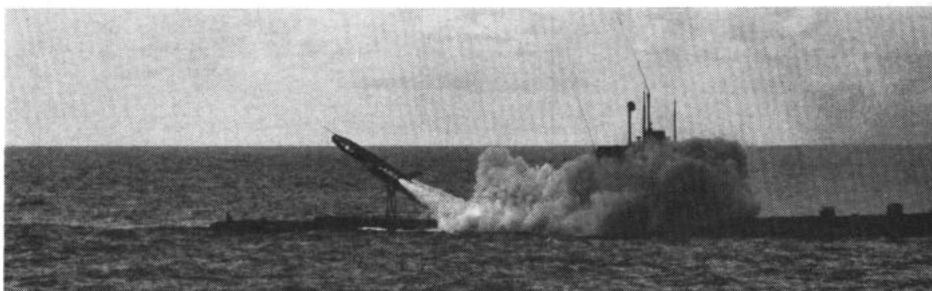
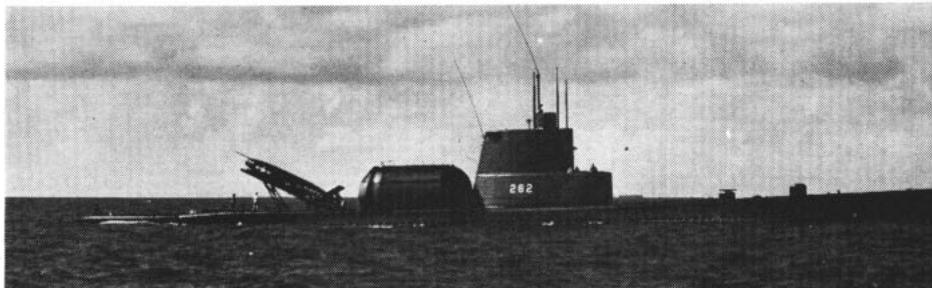
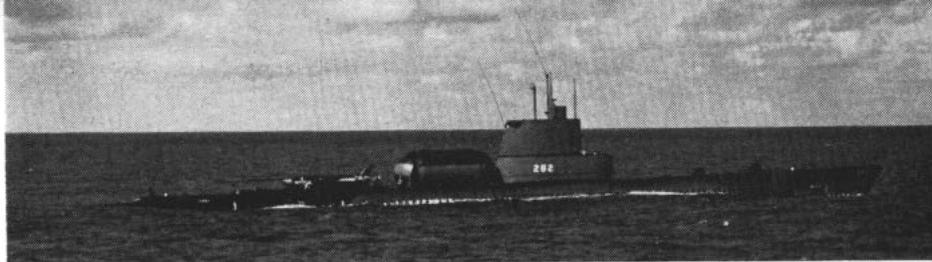
In addition to the guided missile ships that Navy has working topside there is a growing group of sub-

marines carrying deadly long-range guided missiles through the waters below. *uss Tunny* (SSG 282), shown on these pages loading and firing her missiles, and *uss Barbero* (SSG 317) are already with the Fleet. Two more, *uss Grayback* (SSG 574) and *uss Growler* (SSG 577), are being converted to join these undersea missile masters.

*Tunny* and *Barbero* carry the *Regulus* missile in round watertight hangars on their decks just aft of the conning tower. In a matter of

CANNED MISSILES — USS *Tunny* (SSG 282) takes aboard her missile might, *Regulus*,





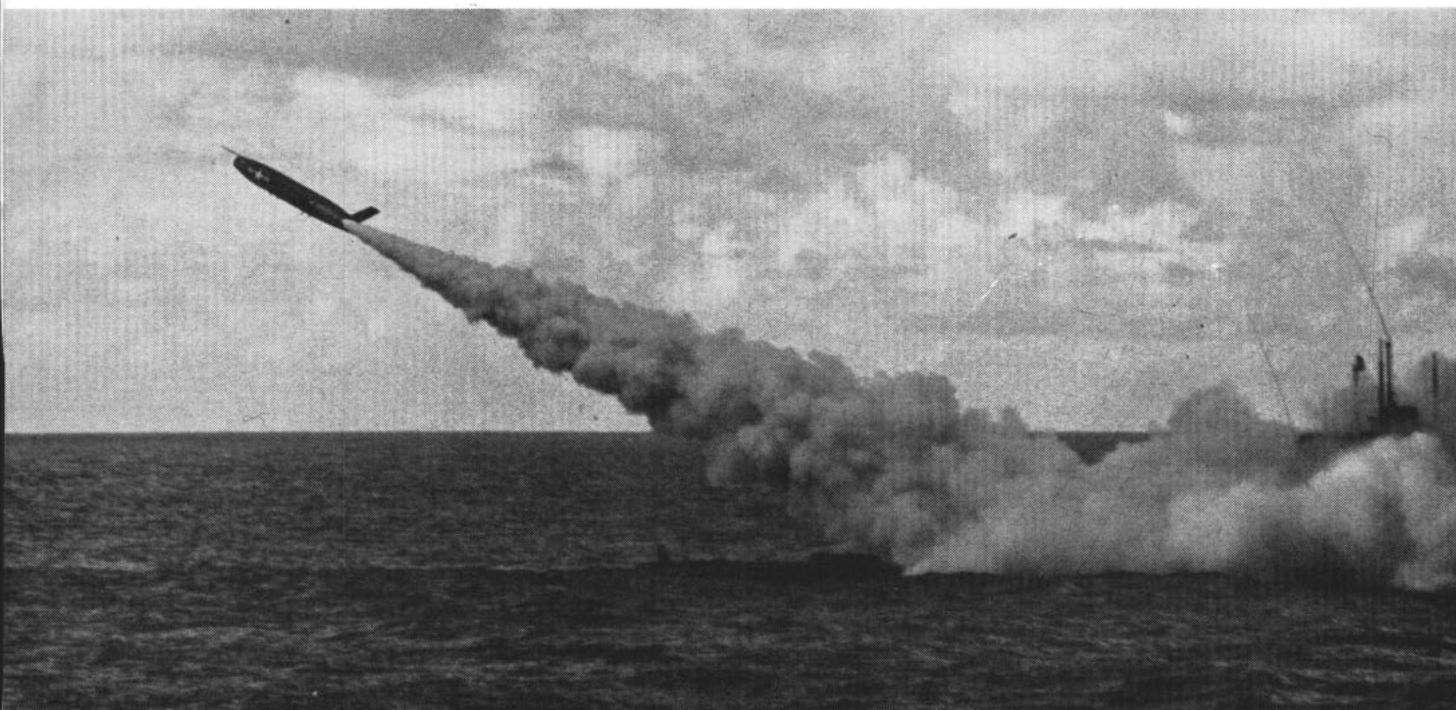
## Missiles Too

minutes after surfacing, their crew can roll out and launch *Regulus*, sending it roaring toward a target hundreds of miles away.

The new guided missile *Polaris* now being developed will further increase the submarine's importance in the missile Navy of tomorrow.

As if this wasn't enough to make Davy Jones abdicate, the Navy is now working on its first nuclear powered guided missile submarine, *USS Halibut* (SSG(N) 587) shown in artist's conception at top left.

and fires it in tests on the high seas.





USS BOSTON (CAG 1), Navy's first guided missile cruiser, heads out to sea, Terrier missiles poised on stern.

the considerations which had to be weighed by BuShips are indications of the shape of ships to come.

Those guided missile ships now in commission have undergone an extensive face-lifting to enable them to carry their new loads. They must have enough space for storage, for assembly, for testing and for launching their missiles. Each missile, for example, requires from 250 to 1000 cubic feet for storage.

Various ships are scheduled to receive missile equipment in the next few years. Some will be of the portable type; most will involve major permanent ship conversions.

Where the portable missile installation is used, major structural changes will be unnecessary. Installation can be made without dis-

## A Report on the World's First Guided

THE TERMS *lock on, track and launch* are not a part of the normal language of most Navymen, but to the Navy's new breed of men, of which the guided missileman is representative, they're familiar, everyday terms. They describe three steps in launching missiles on board the growing Fleet of guided missile ships.

There's quite a story behind each one. The roster of the present guided missile surface ships—the two cruisers, *uss Boston* (CAG 1) and *Canberra* (CAG 2), the destroyer *Gyatt* (DDG 712) and the experi-

mental ship *Norton Sound* (AVM 1)—will soon be obsolete, but these names will live for years to come. The same goes for the guided missile submarines, *uss Tunny* (SSG 282) and *Barbero* (SSG 317)—discussed on page 24. They do not have spectacular dimensions, nor do they have the glamor of *Forrestal* or *Nautilus*, but they carry within them the promise of the future.

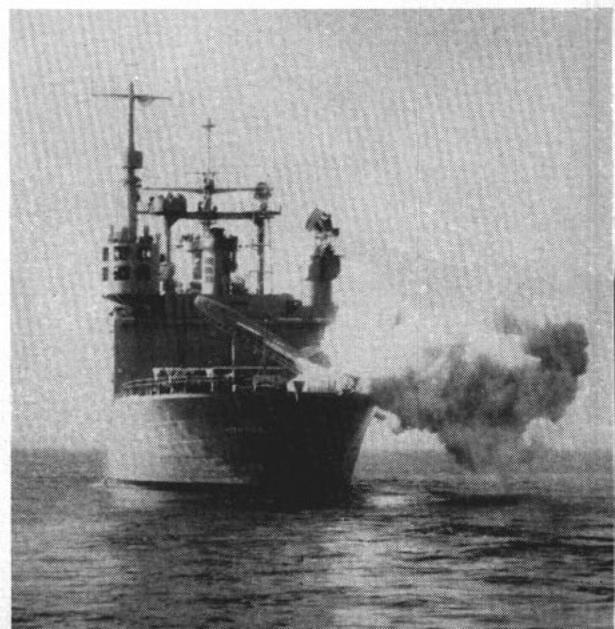
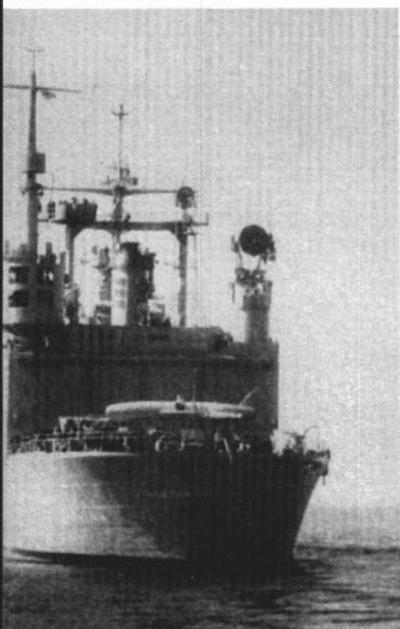
There were plenty of problems connected with the guided missile ship conversions as discussed in the article beginning on page 6, and

turbing other armament, and launchers can be removed with equal ease. However, it is still necessary to provide weight compensation for the missile installation.

Most of the electronics checkout equipment needed for these portable installations is placed aboard in portable vans, eliminating the need for stowing this gear on the ship as individual items.

On the other hand, a major ship conversion is necessary for permanent missile launchers. This means a long shipyard session. Here, actual

AS TEST SHIP *Norton Sound* has fired many Navy guided missiles and rockets including the king-size *Viking*.



structural changes must be made to give the needed weight compensation and allow space for the launching equipment. The vast amount of electronics gear that must go into these permanent conversions also makes it necessary to remove some of the "old" in favor of the "new."

Here are some of the problems peculiar to guided missile conversion:

- Whether fixed or portable, the launchers must be stable and must be able to grip the missiles firmly to prevent damage and give split-second release at the instant of firing.

- All of the fuels used for the missiles are fire hazards and some are toxic. For the first time several explosives are handled in one magazine. This means new arrangements and new handling procedures.

- The deck below the launcher must be stable enough to withstand the heat of the jet blast. If an accident or misfire occurs, the ship has

## Missile Ships

to be capable of absorbing shock.

Testing and developing missiles aboard ship is the only sure-fire way to get better missiles, as has been proved in the conversion of two heavy cruisers, a destroyer and a seaplane tender.

Here's a brief rundown on four of the ships playing a big role in the new Guided Missile Navy.

**USS Norton Sound** (AVM 1) is one of the first ships converted to handle and launch guided missiles.

The first ship designed and built from the keel up as a seaplane



**HIGH TEST** — Navy surface-to-surface guided missile roars off its launching platform on a test flight using JATO rocket bottles to speed its getaway.

tender, *Norton Sound* was launched 28 Nov 1943. In early 1945, she earned her first engagement star for the assault and occupation of Okinawa. For her support in the Third Fleet operations against Japan she earned her second star. (She also earned eligibility for the Navy Occupation Service Medal, Asia, and the China Service Medal Extended.)

Known as the "sea-going laboratory" after her conversion from AV to AVM (Guided Missile Ship), *Norton Sound* has carried out experiments with a number of guided missiles and rockets. She first fired the *Loon*, then the *Aerobee*, *Terrier* and later the *Regulus*. Below deck, *Norton Sound* has equipment that approaches the status of a laboratory. Topside, her launchers and special equipment have handled the *Viking* and many other missiles.

Further guided missile testing is being continued with *USS Boston*

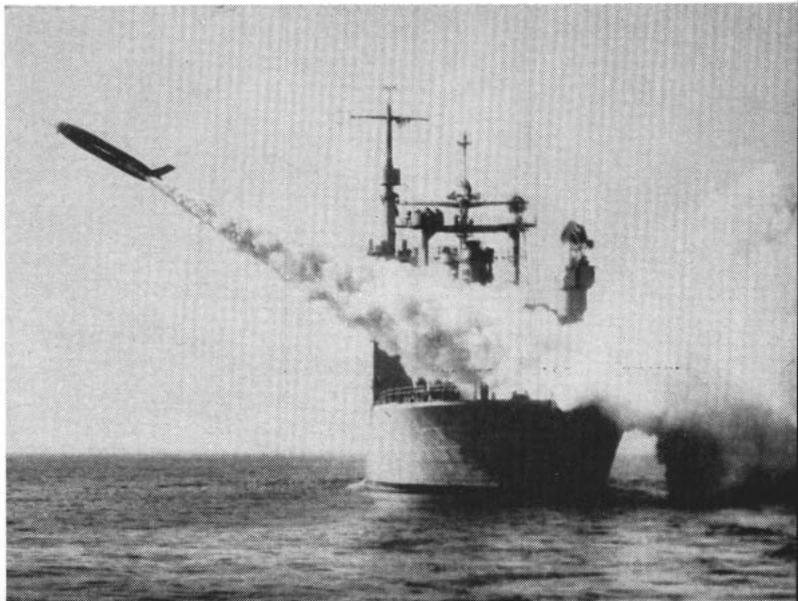
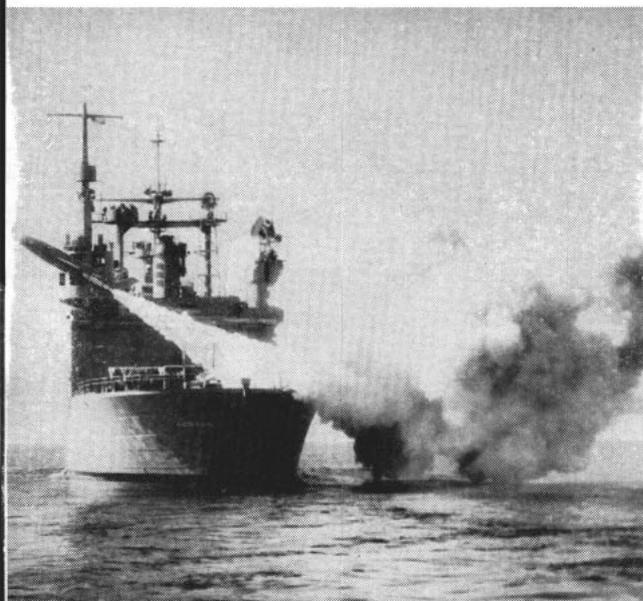
(CAG 1) and *USS Canberra* (CAG 2).

**USS Boston** is the sixth Navy ship to bear that name. She was launched 26 Aug 1942, as a *Baltimore* class cruiser and saw World War II service with Task Force 58 at Eniwetok Atoll, Marshall Islands, for which she was awarded the Asiatic-Pacific Campaign Medal. She later took part in the first raid on the Palaus and the Western Carolines, then saw service in Western New Guinea, the Marianas, Western Caroline Islands, Leyte, Luzon, Iwo Jima, and Japan. She was awarded the Navy Occupation Service Medal, Asia, and 10 engagement stars with the Asiatic-Pacific Campaign Medal.

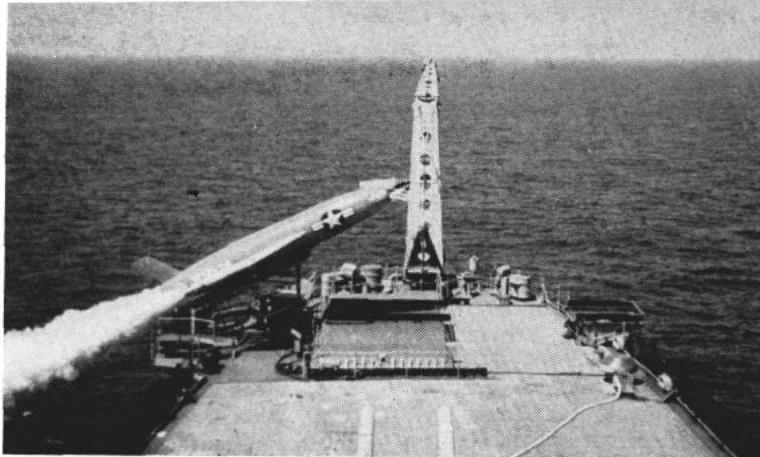
In 1946, she was taken out of commission in the Pacific Reserve Fleet at Bremerton, Washington.

*Boston* was later ordered to New York for conversion and in November 1955 was recommissioned as the

**FORMER SEAPLANE TENDER USS Norton Sound (AVM 1) now has the unusual job of seagoing guided missile lab.**







USS GYATT (DDG 712) cruises Atlantic. Right: Regulus SSM guided missile is readied on fantail of a cruiser.

first surface-to-air guided missile cruiser. Her length is 673'; she is armed with six eight-inchers, 10 five-inchers, and antiaircraft guns in addition to *Terrier* missile launchers.

*uss Canberra*, another World War II veteran with a guided missile future, is also a *Baltimore* class cruiser. She was launched as CA 70 on 19 Apr 1943.

She saw action in Western New Guinea, the Marianas, Western Caroline Islands, Hollandia and Leyte. As a result of the Leyte Operation *Canberra* was forced to return to Boston for repairs and then joined the Mothball Fleet at Bremerton (carrying seven stars on her Asiatic-Pacific Campaign Medal).

In 1952, *Canberra* went to New York for conversion and, in June of that year, was recommissioned as the second surface-to-air guided missile cruiser, CAG 2, with a battery of *Terrier* launchers.

*USS Gyatt* (DDG 712), the Navy's guided missile destroyer, recommissioned on 3 Dec 1956 as a "390-foot destroyer with a weapon equal to that installed in a 45,000-ton ship," was originally commissioned on 2 Jul 1945 as DD 712.

*Gyatt* operated with the Atlantic Fleet for 10 years until she reported to Boston on 1 Nov 1955, for decommissioning and conversion as a guided missile ship.

Profiting by tests and experiments on other missile ships, *Gyatt* is the only ship of her class sporting a *Terrier* launcher.

She is also the first of the destroyer force of "giant killers" to have stabilizing fins to give more accurate firepower.

Another important first for *Gyatt* is her use of the horizontal stowage of missiles on a revolving circular magazine. This allows for more efficiency of missile-handling.

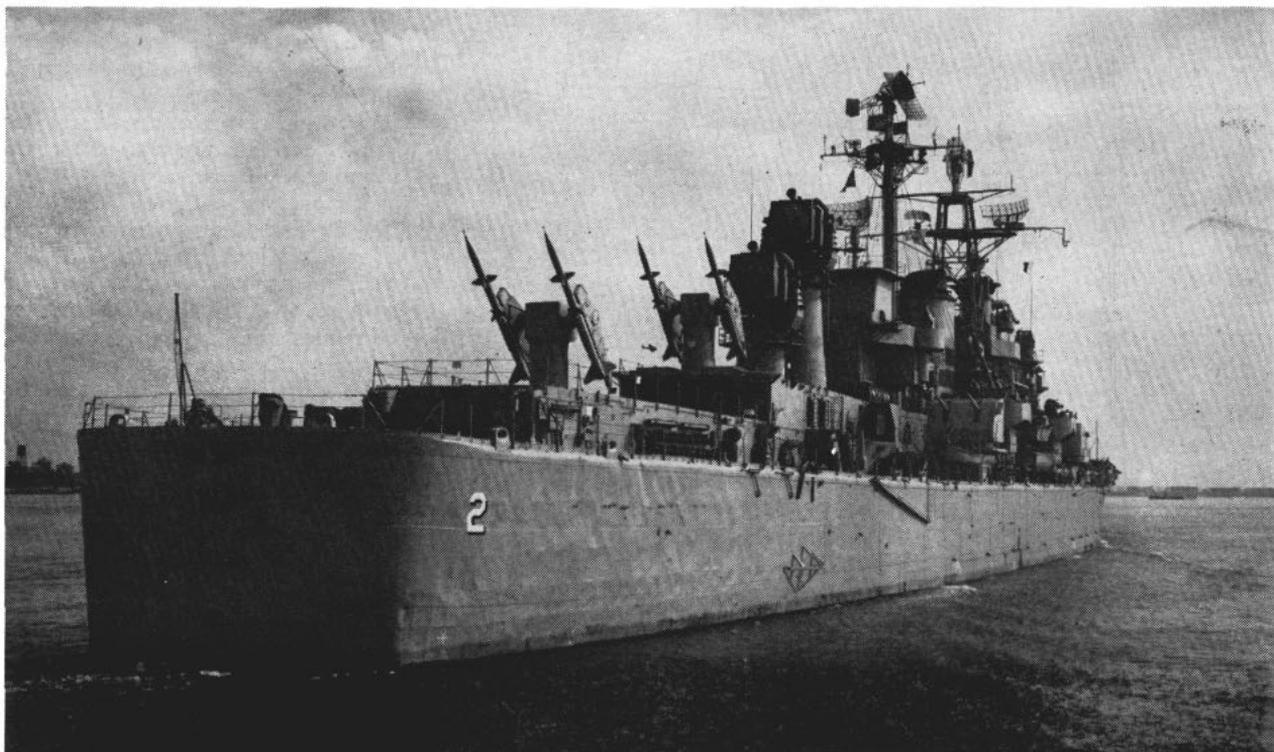
These conversions stand as only a few in the Navy's missile Fleet. The Navy, in its program for fiscal year 1957, is following the proven method of solving missile problems by trial installation and tests. Among other Navy ships scheduled for new construction or conversion in the 1957 budget are CLGs, DLGs and DDGs.

The Navy's guided missile force may also count on additional strength through such ships as *uss Hancock* (CVA 19), *Midway* (CVA 41), *Helena* (CA 75), *Los Angeles* (CA 135), *Macon* (CA 132), and others. Although these ships are not included in the guided missile category, they are known to be capable of launching missiles.

Thus it's plain to see that guided missiles are slated to play an increasingly important role in the Navy's shape of ships to come.

—Charles A. Robertson

MISSILE MISS — USS *Canberra* (CAG 2). Left: USS *Mississippi*, now scrapped, launches *Terrier* missiles.



# Test Centers Keep Missiles on the Go

WHERE DO GUIDED MISSILES come from? Who does the research and development? The answer becomes a little complicated.

In the Navy Department, the responsibility is borne by three Bureaus—the Research and Development Division of BuOrd, the Guided Missile Division of BuAer, and the Shipbuilding and Ship Maintenance Division as well as the Electronics Division of BuShips.

The Bureau of Ordnance and the Bureau of Aeronautics approach the problems they face quite differently. BuOrd problems are referred to educational and scientific institutions or to Ordnance Laboratories. BuOrd may, for example, award a contract to one of these agencies to determine feasibility of and to develop a certain kind of missile, offering them a more or less free hand in the necessary research. The actual work is done by

the institution, subject to Bureau approval.

On the other hand, BuAer follows the policy of decentralization of assignment of projects directly to the manufacturers.

Several ranges have been set up by the Department of Defense for testing guided missiles and all of these ranges have an elaborate network of instruments to observe the action of the various missiles. Many differences exist in the individual setups of these ranges because each has different problems to investigate.

Here's a brief summary of the more prominent:

- **White Sands Proving Grounds—**

This is located about 25 miles east of Las Cruces, New Mexico, is administered by the Army's Ordnance Corps, and staffed by Army and Navy personnel.

- **The Naval Ordnance Missile Test**

*Facility* was established by BuOrd with base facilities at White Sands. The Navy has also sponsored additional base facilities which include missile assembly, machine shops, storage, BOQs, access roads and launching facilities for *Aerobee* and *Viking* (which are upper air research vehicles) and surface-to-air missiles.

Instruments for observation extend for about 45 miles up range of the launching site, sufficient to provide adequate coverage for missiles traveling the entire range of about 100 miles. Tests are conducted on:

Vertically fired missiles;

Missiles which reach altitudes of more than 60,000 feet;

Surface-to-surface missiles with ranges of from 25 to 70 miles.

- **Holloman Air Force Base**, also located in New Mexico not far from White Sands Proving Ground, is the only guided missile test range at which no naval personnel are stationed. It is administered and staffed by Air Force personnel. The firing range is the same acreage as that used by White Sands and permits testing to ranges of some 50 miles. Holloman tests four types of missiles: surface-to-surface, surface-to-air, air-to-air and air-to-surface.

- **Point Mugu, Calif.**, officially designated as the *Naval Air Missile Test Center*, is described in some detail on pages 34 to 37 of this issue.

Point Mugu, located on the shore of the Pacific Ocean about 60 miles northwest of Los Angeles, was selected as the site for the Center because of its favorable year-round climate, the availability of a deep and extensive ocean area for a test range, and offshore islands for instrumentation stations.

The mission of the U.S. Naval Air Missile Test Center, Point Mugu, is to test and evaluate guided missiles, their components and related weapon systems; to operate aerodynamic test equipment as required; to provide initial training for specified personnel and nucleus Fleet units in the preparation, maintenance and operation of new guided missiles; and to provide technical services support for Fleet Activities designated to assist NAMTC in the performance of the basic test and evaluation mission.

Missiles are fired seaward from the shore or are launched from or

OUT OF THIS WORLD—Navy's *Viking* rocket undergoes adjustments prior to launching during high-altitude tests at White Sands Proving Ground.





CHINA LAKE Naval Ordnance Test Station has job of checking missiles. It is located in the California desert area.

near San Nicolas Island. Types tested are: air-to-air, surface-to-surface, surface-to-air and air-to-surface.

• **China Lake, Calif.**, known informally as NOTS, or *Naval Ordnance Test Station*, is a completely equipped research and development test station for various types of ordnance material, especially rockets and guided missiles. It is staffed by highly skilled scientific and technical personnel to carry out research, development and testing in a broad field of interest to ordnance application.

One range is used primarily for guided missiles. It covers a pie-shaped sector of about 25 degrees extending about 35 miles. The range offers a complete system of communications and is equipped for radar, optical, and Doppler tracking;

and for telemetering. Emplacements and launchers for various types of missiles have been constructed. Details of China Lake may be found on pages 59-63 of the March 1956 issue of ALL HANDS.

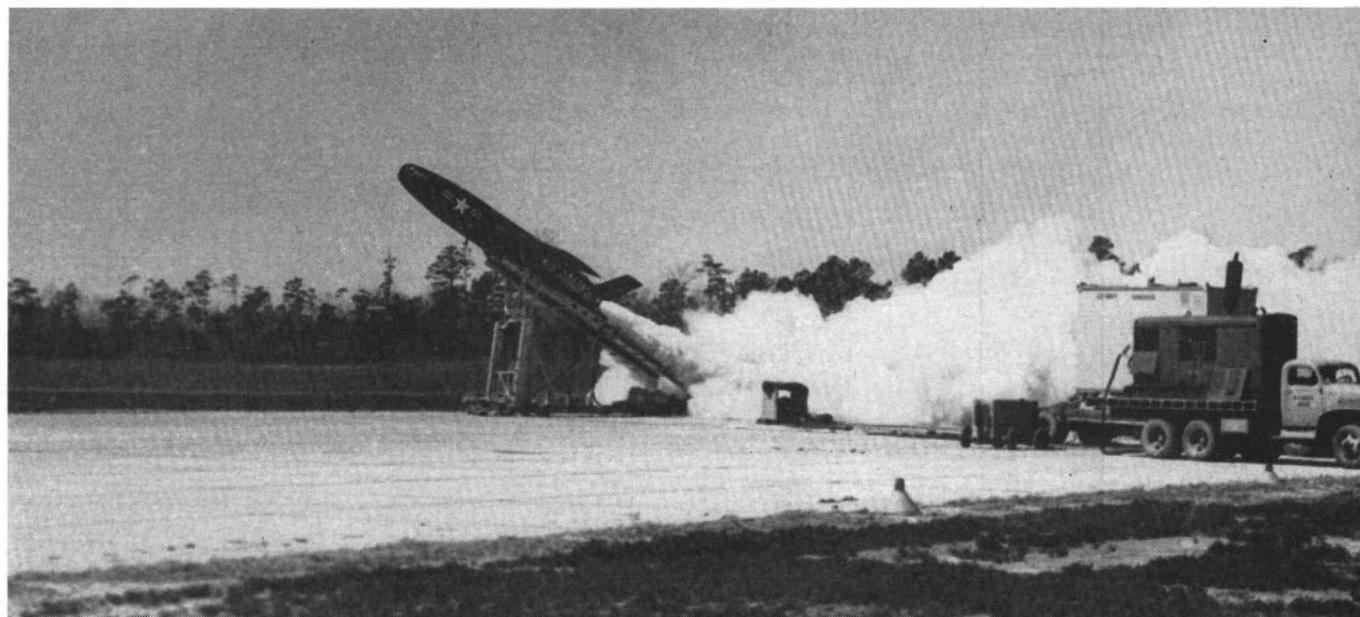
• **Chincoteague, Va.**, is the site of the *Naval Aviation Ordnance Test Station*. Administered by BuOrd, it was originally established to provide a location on the East Coast where tests of aviation ordnance could be made, but the mission of the station has since been extended to include guided missile tests.

The land range consists of a one-by-five-mile strip about five miles from the station and the range can only be reached by boat. There is a sea range operating area 50 miles east of the station over the open sea. In addition, there is a 16-mile sea range extending parallel

to the beach. Chincoteague is the Navy's principal facility for testing air-to-surface missiles.

• **Patrick Air Force Base**, Cape Canaveral, Fla., is the long range proving ground for the Armed Forces. The Navy currently maintains a small *Naval Unit* for liaison purposes at this activity. By mutual agreement between the governments of the United Kingdom, the Bahamas and the United States, instrument stations have been located on various islands within the Bahamas to detect a missile's passage. The entire range is under visual and radar inspection during test flights to avoid the possibility of missiles colliding with aircraft or landing within the vicinity of any surface craft. Should the controls fail, the missile is destroyed in the air before leaving the safe range area.

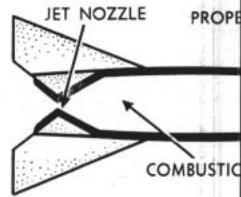
CHINCOTEAGUE SAILORS at Aviation Ordnance Test station send *Regulus* off on a guided cruise over Atlantic.



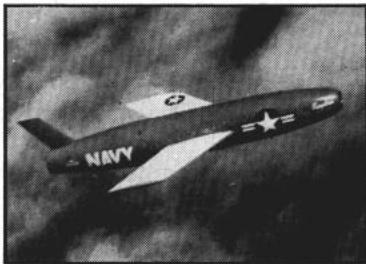
# THE GUIDED M



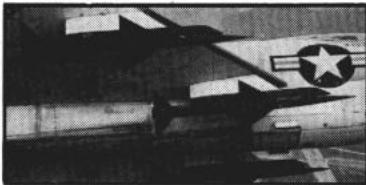
Capable of Destroying an Enemy Attack, Whether by Supersonic Airplane or Modern Sub, USS Gyatt Is Navy's First Guided Missile Destroyer. It Is Equipped With Stabilizing Fins.



CUTAWAY OF MISSILE POWERED



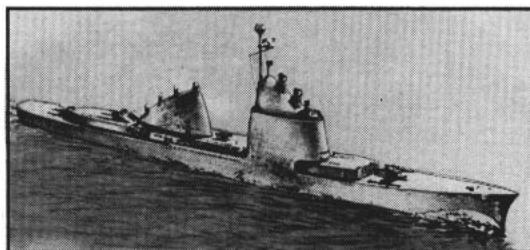
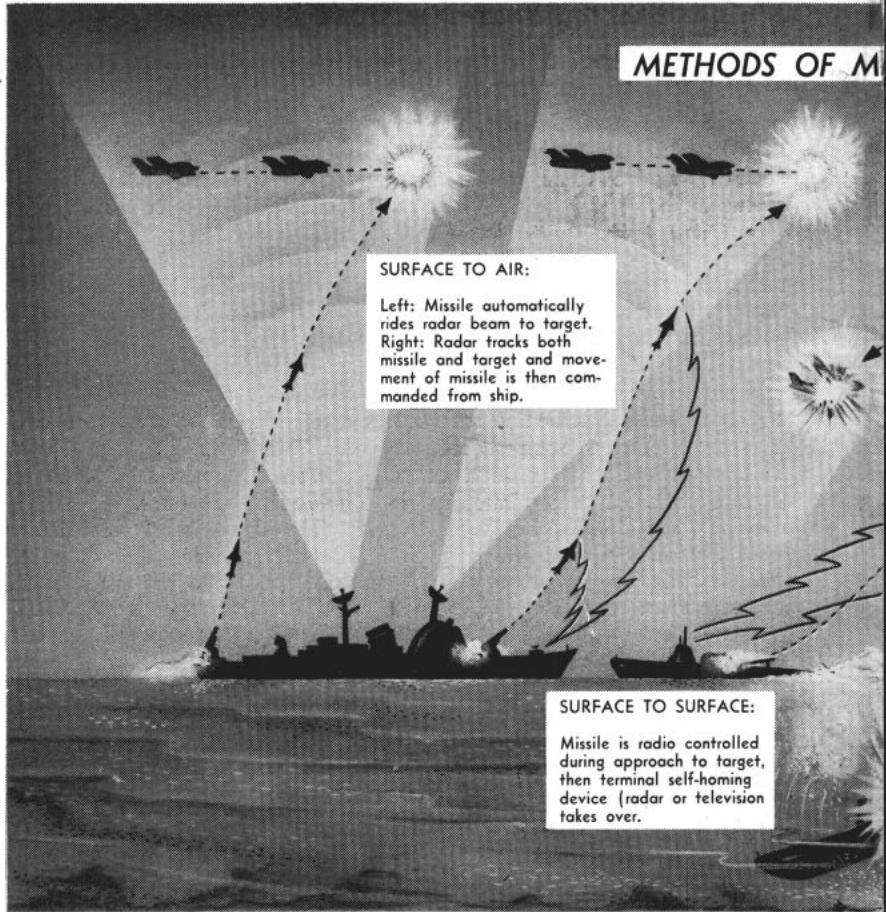
The Easily-Installed Turbo-Jet Regulus Is a Huge Surface-to-Surface Guided Missile.



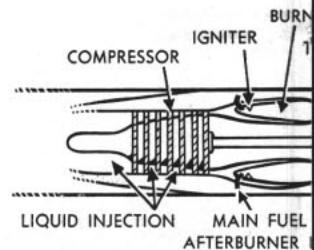
Sparrow Missile Is an Air-to-Air Weapon That Is a Powerful Deterrent Against Planes.



Petrel, Designed for Use Against Enemy Ships, Is Equipped With a Self-Homing Device.

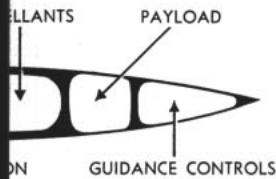


Artist's Conception of the Proposed Nuclear-Powered, Guided Missile Cruiser Designed to Be Effective Against Any Target.



CUTAWAY OF MISSILE POW WITH AFTERBUR

# MISSILE NAVY

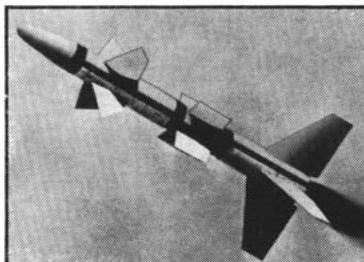


BY SOLID FUEL ROCKET MOTOR.

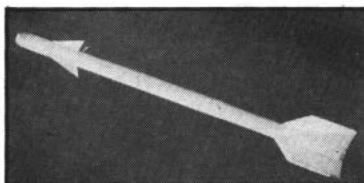


The Heavy Cruiser *USS Boston* Is the First Navy Warship to Carry the Guided Missile Designation of CAG. She Helped to Introduce a New Concept in Navy Weapons.

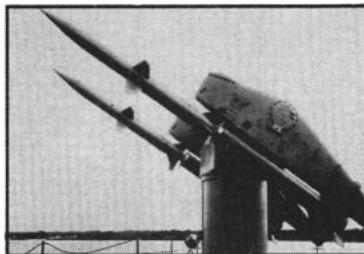
## MISSILE GUIDANCE



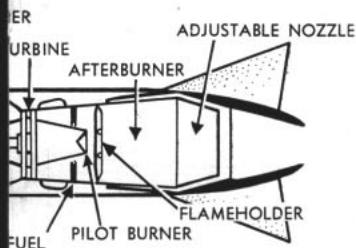
Navy *Talos* Is a Supersonic Surface-to-Air Missile That Is More Effective Than Terrier.



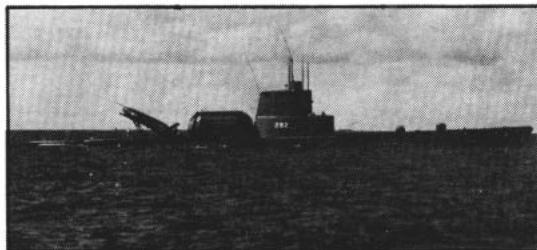
*Sidewinder* Is a Simple, Inexpensive Yet Highly Effective Air-to-Air Missile.



Slim, Needle-Nosed *Terrier* Is a Supersonic Guided Missile Used Against Aircraft.



OPERATED BY TURBO JET ENGINE  
(RAM JET).



The Guided Missile Sub Is an Important Phase of the Missile Program. *USS Tunny* (SSG 282) Carries Long Range *Regulus* I.

# MISSILES a la MUGU

*The outcome of any future engagement may very well depend upon the operation of one of thousands of minute parts in the weapon of the future—the guided missile. Pt. Mugu, Naval Air Missile Test Center, makes sure that it will work right the first time.*

**T**RADATION HAS IT THAT, some 415 years ago a sea-weary Spaniard, Juan Cabrillo by name, made a landfall in a charming lagoon on the California coast about 55 miles north of present day Los Angeles. As almost every later historical reference explains, the current residents, the Chumash Indians promptly named the site "Mugu" (Place of Landing).

The lagoon is gone today and so is Cabrillo and his Indians. Were Cabrillo to succeed in passing the Pt. Mugu security guard he would find, instead of his half-naked savages living in mud huts, roving the mountains and combing the beaches for

food, a test center for one of the most efficient and deadly weapons man has yet devised—the guided missile.

Until some 10 years ago, Pt. Mugu was still a swampy stretch of tideland. Today, Cabrillo's quiet beach is seared, day after day, by great blasts of flame and smoke as missiles streak seaward from Pt. Mugu's launching pads. As one of the Navy's guided missile test centers, comparable to the USAF Missile Test Center at Cocoa, Fla., and the Army's White Sands Proving Ground in New Mexico, Mugu has the mission of testing and evaluating guided missiles and their components.

The test center was originally planned during World War II, when the Navy realized that the weapons then under development would require extensive areas of land and water for proving grounds. After considerable exploration of various

sites throughout the country, the Naval Air Missile Test Center (NAMTC) was established here in October 1946.

In the years following the establishment of NAMTC, the area has grown from a few huts scattered on the beach to a modern city covering more than a thousand acres. Pt. Mugu itself covers some 4234 acres.

During the 10 years since NAMTC was officially established, the facility has conducted thousands of experiments and tests on guided missiles and pilotless aircraft and, in addition, has developed a well organized test center for some of the most advanced missiles in the nation's defense arsenal. Now a \$55,000,000 establishment, it consists of clusters of buildings, hangars, and field equipment, and supports the 540-foot, 14,800-ton *Norton Sound* based at nearby Port Hueneme.

Because the testing conducted by the Center requires vast areas over water, some 11,000 square miles of the adjoining Pacific Ocean have become a part of the facility.

During the course of this development, NAMTC acquired 14,000 acres of land on San Nicolas Island, 60 miles southwest of the Center. The offshore station on this island has its own airstrip and technical facilities. Other smaller parcels of land—all contributing to the testing operations—have become a part of the facility. These include 40 acres on Laguna Peak, 57 acres on Santa Cruz Island, and five acres on Santa Rosa Island.

Several of these islands are equipped with radar, optical and photographic gear so that a continuous record may be obtained of a missile's course once it has been launched. The island tracking facilities are also used by *uss Norton Sound* (AVM 1) and submarines such as *Tunny* (SSG 282).

At Point Mugu, the Navy tests guided missiles such as *Regulus*, a missile that is fired from a launching site on the ground or aboard a ship or submarine, and intended to hit another surface target; *Terrier*, a surface-to-air missile, and *Sparrow*, an air-to-air guided missile.

Facilities for missile testing include the main site at Point Mugu,

**HIGH TEST** — Navy surface-to-surface guided missile roars off its launching platform on a test flight using JATO rocket bottles to speed its getaway.



**ALL HANDS**



CAMERAS AT San Nicolas record *Regulus* flight. Below: Camera photographing it from air is removed from pod.

with launching pads and control building and an airstrip, and radar systems that operate to track the flight of a missile. A system of theodolites (large telescopes with cameras) also goes into operation to take photographs of the missile's progress. Other photographs are taken by airborne cameras. Facilities also are furnished by the Navy so that designs of civilian firms may be tested. At present, 18 civilian contractors have hangar space beside the Point Mugu naval air station field.

The actual launching of a missile is no casual affair. Thousands of man-hours of labor go into the preparation long before the moment of firing. Hundreds of men have to be alerted. Airplanes are sent out to make sure no ships or other surface craft are in the sea test range area which might be in danger of being hit. The people who actually do the firing, the men who take down the data that is collected, all have to be ready.

In the case of *Regulus*, the missile rests on its cart on a rail launcher. Experts make last-minute control checks. The jet engine is started. Then with the jet engine roaring, the rocket assist takeoff (JATO) goes into action.

Within a few seconds the bottle is burned out and is ejected automatically, leaving the missile in the air dependent only on its engine and

ground electronic controls for successful flight.

The men who launched the missile into the air have been operating a control board from inside a concrete revetment. They are able to watch the launching from a safe place by means of television. (A specially built television camera stands a few feet from the missile at the takeoff, and relays a full visual picture of what is happening.) Special telemetering equipment has been designed so that every step of each brief missile flight can be recorded and interpreted.

The need for this detailed knowledge of how each control works is based on two things. The Navy wants to eliminate all guesswork. Secondly, a test missile may cost anywhere from \$25,000 to \$250,000. Mistakes can be expensive in time and money.

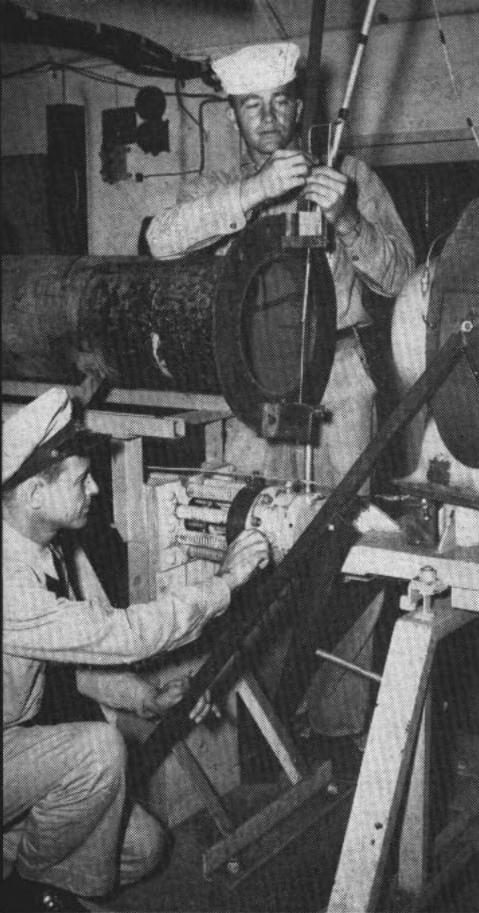
Some missiles are designed, in their test and drone versions, to be recoverable. After they are launched they generally can be guided to a safe landing after completion of their missions.

The test and evaluation of a new type of missile can take many months.

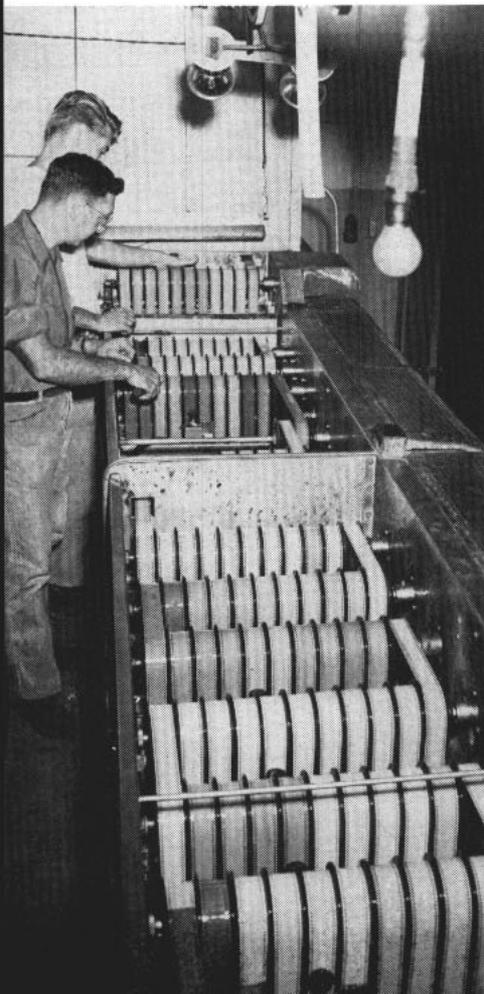
The test center provides the contractor with facilities for launching and testing missiles. The contractor is allowed to make five or 10 test shots. After he has completed these firings, the Navy may let a limited

contract to see if he can produce missiles in larger volume and turn out a standardized product. The next phase is to evaluate these missiles, which are machine-made, as contrasted to the prototype, which is largely hand-made. If they are satisfactory, the Navy may then award a contract for volume production of the missiles.





MUGU 'CREW' work on missile power plant in engine test pit. Below: Film shot during missile tests is developed.



Responsibility for the test and evaluation of guided missiles and their components is that of NAMTC's *Test and Evaluation facility*, which is composed of five technical departments. All are directly involved in, and responsible for, the testing activities of the center.

Actual flight testing of guided missiles and pilotless target aircraft is conducted by one or another of the three missile divisions of the *Missile Test Department*.

A typical flight test program usually consists of an evaluation of the missile's remote control equipment, performance characteristics, flotation capabilities and over-all suitability for Navy use.

A group of civilian engineering personnel is assigned to the *Missile Division* to assist the Navy in this evaluation.

NAMTC's nerve center, in so far as missile operations are concerned, is the *Flight Test Control Area*. Here can be found the instruments used for the final checkout of the missile on the launching platform; firing sequence timers; instruments that record the data pouring in from tracking stations; computers and analyzers used in reducing the mass of data down to the exact performance characteristic desired; and special destructor controls to blow the missile to pieces should it edge outside the limits of the range.

In a specially designed room at Point Mugu, a huge \$3,000,000 electronic marvel that can perform approximately six million mathematical operations in five minutes running time is used by NAMTC personnel to work out equations and problems that would take an average mathematician at least four years to complete.

The device checks itself 10 times for accuracy before producing an answer.

Additional Navy facilities have joined the Point Mugu official community. In September 1948, the Naval Air Facility was expanded and in the following years established as the Naval Air Station, Point Mugu.

The mission of the Naval Air Station is to assist and support crews in the testing of missiles and certain types of aircraft.

Other military activities in the area also contribute their services. The Naval Construction Battalion

Center, home of the Seabees, is at Port Hueneme, seven miles up the coast where ships and small craft of various kinds are based.

The Navy's extensive and well organized facilities at NAMTC not only serve and advance the work of military groups but they also aid the work of a number of contractors who are involved with military problems.

In addition to the industrial contractors at NAMTC, there are groups such as the Engineering Center of the University of Southern California. The 55 people of this unit work in the Aerodynamic Test Division. The supersonic wind tunnel at NAMTC was designed by the engineering unit from USC. Other missile-connected work contributes to the advancement of young professional people who comprise the group.

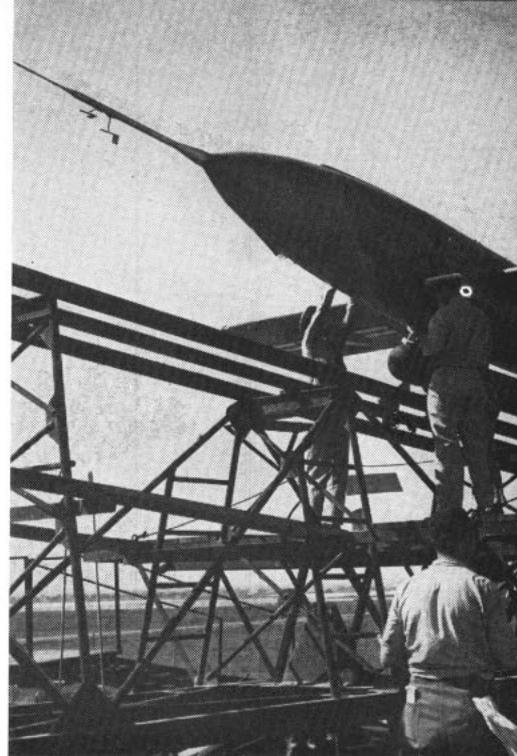
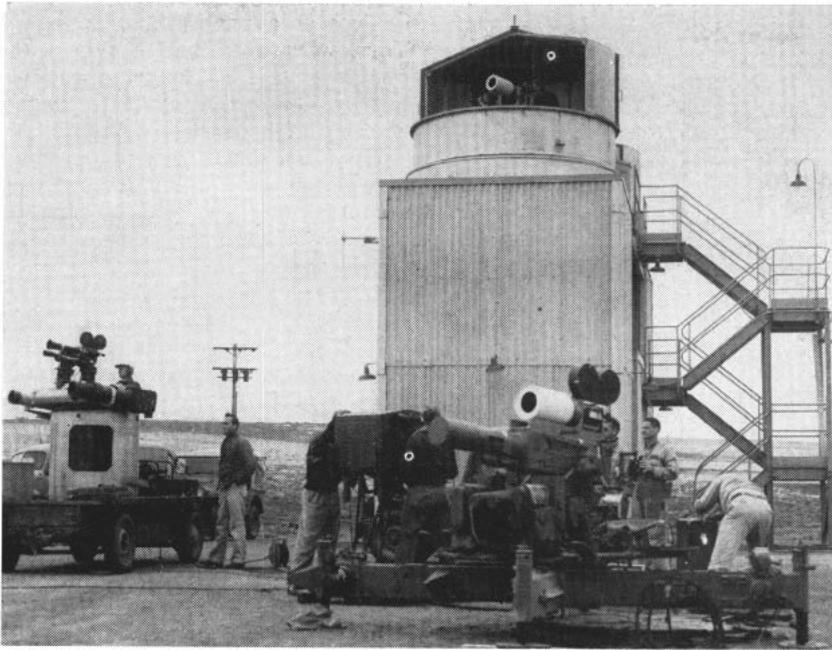
Reserve officer training goes forward at NAMTC as it does in many another naval facility or organization. A unique Reserve training unit, known as BARTU 777 of the Bureau of Aeronautics, trains on a regular schedule.

There are more than 30 members in the unit, and combined they represent an approximate aggregate of 300 years in formal engineering and technical education as well as 400 years of Reserve duty in naval aviation.

ONE OF THE MORE UNUSUAL features of Pt. Mugu—from the viewpoint of its history, the job it performs, and type of duty for Navymen—is windswept and barren San Nicolas Island.

Bucking the waves and wind beyond the Santa Barbara Channel about 60 miles off the Pt. Mugu coast, this island and its larger neighbor, Santa Cruz, are important links in the Naval Air Missile Test Center's range instrumentation chain. In fact, the presence of the islands greatly influenced the selection of Point Mugu as a possible site for the test center.

San Nicolas, nine miles long and averaging three miles wide, is occupied solely by the Navy. Years ago remnants of the tribe of Chumash Indians eked out an existence there, but the last few members of the tribe were removed to the mainland in 1835. From that year until the NAMTC was established in 1946 the island was visited only by fishermen, sealers, sheep herders and a



TURRET CAMERAS follow path of test missile, recording its performance. Right: Missile is readied for its flight.

few scientists looking for Indian artifacts.

Today the island is laced with a maze of electronic networks. The roar of aircraft competes with the howling of the wind and the inhabitants spend their time recording the antics of guided missiles or supporting the recorders.

Navy men are assigned to San Nick for three to six months, but many of them find that they like the place and request extensions which are usually granted. Since activities on the island are part of the NAMTC mainland operations and the island itself is part of Ventura County, (since 1872), Navy men receive no extra pay for sea duty.

In regard to facilities, San Nick appears much as the main Center did a few years ago. Most of the buildings are temporary, but a constant maintenance program, carried on in the face of almost continually adverse weather conditions, keeps them relatively shipshape. A few patches of lawn have been attempted, but with more hope than success.

During the past few years a number of permanent, modern structures have been erected.

Most of these are technical facilities, but a new concrete barracks has recently been completed and an impressive galley and messhall which features much glass and a lusty, seldom silent radio with a mania for

hill billy music has been in operation for several years.

Keeping the men on this outpost supplied with the essentials of life and with equipment with which to work is the primary job of the Island Facilities Department.

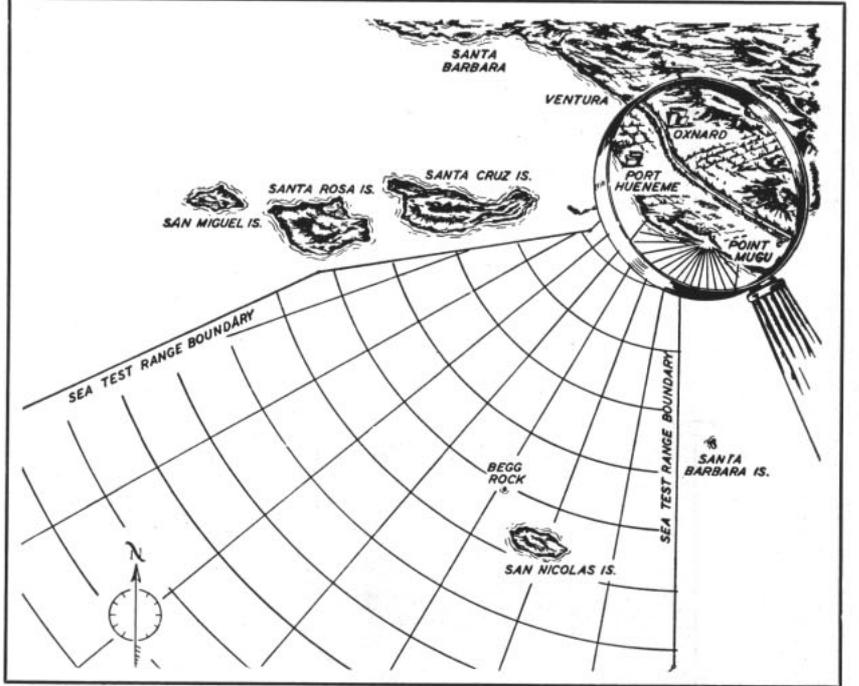
The bulk of the island's needs is supplied by boat, primarily LSUs, which must be beached for unloading.

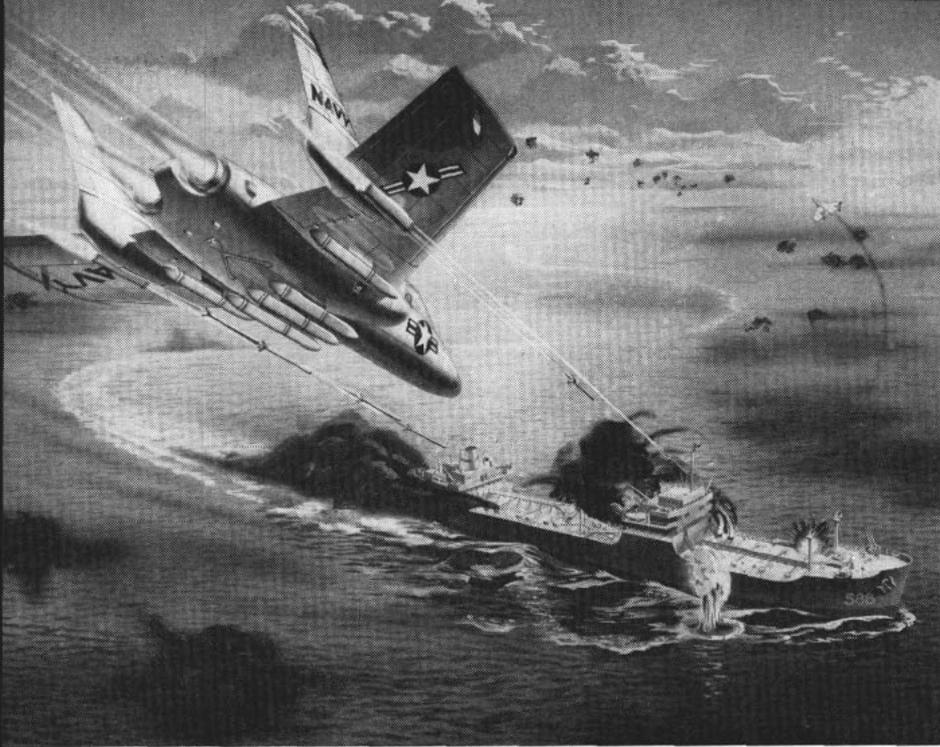
Rough weather often makes the

beaching operation unsafe and delays the arrival of materials, sometimes for several days.

In spite of the sometimes primitive living conditions and frequent bad weather, morale on the island is unusually high. Those who don't take to the isolation or lack of privacy usually don't stay long, and as a result the "islanders" who remain are as cheerful and easy-going a group as can be found in the Navy.

CHART shows Point Mugu and Sea Test Range for missiles and missileers.





ROCKETING AHEAD—Artist's conception shows tomorrow's rockets in action.

devices or a remote control setup. Thus, when a "rocket" is subject to guidance it is no longer a rocket, but a guided missile, which the DOD glossary (See page 3) defines as:

"An unmanned vehicle moving above the earth's surface, whose trajectory or flight path is capable of being altered by a mechanism within the vehicle."

Man has known about rockets for many centuries, and it was way back in the year 1232 A. D., when the Chinese first used them in combat (See page 58). Yet, for more than 700 years the vast potential of the rocket, both as a weapon and as a means of propulsion, was largely ignored.

The first real exploitation of the rocket as a weapon didn't come about until the first half of the 19th century, when the British, after encountering them in India, used them with considerable success in the

# A Rocket Is a Missile Without

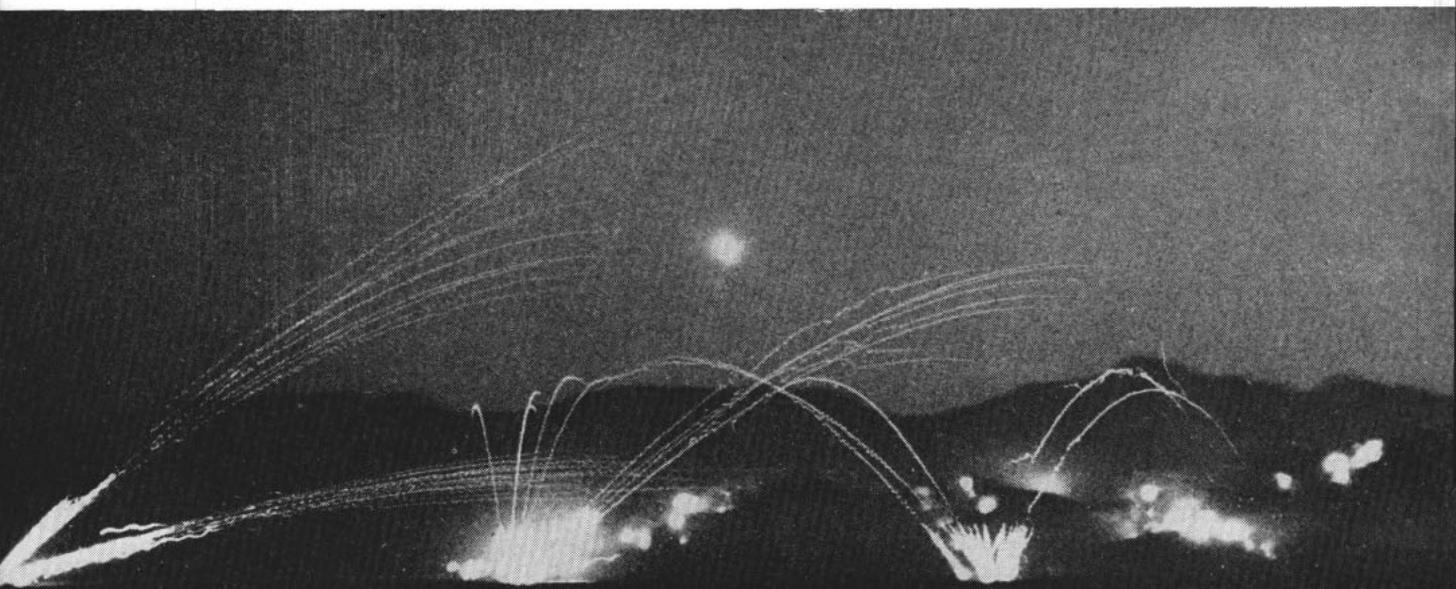
**W**HAT is a rocket?

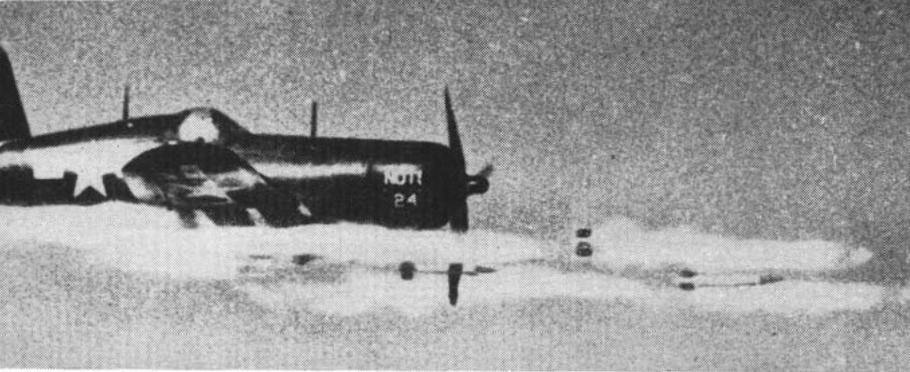
According to the glossary of guided missile terms used by the Department of Defense, it can be either "a thrust-producing system or a complete missile which derives its thrust from ejection of hot gases generated from material carried in the system, not requiring intake of air or water."

Actually, though, when a missile-man talks about "rockets and guided missiles," he means quite a bit more than that. To him, a "rocket" has no more means of guidance—once it is launched—than a bullet has once it leaves the barrel of a rifle. On the other hand, a guided missile (even though it may be rocket-propelled) is "steered" in flight by self-contained

Napoleonic Wars and the War of 1812. At the Battle of Bladensburg (24 Aug 1814) rockets helped defeat the inexperienced American troops defending Washington, D. C., and the following month British "rocket ships" were employed in the bombardment of Fort McHenry. There, a hidden battery sank one of the ships with all hands and the

'RED GLARE' of rocket's fire from Navy LSMR shore bombardment on Korean coast creates pattern of destruction.





ROCKET REVIVAL in WW II brought air-to-ground rockets like these. *Right:* High-flying Navy research rocket, Aerobee, takes off to explore the sky.

other rocket craft were forced to withdraw without accomplishing their missions. However, their fire made such an impression on Francis Scott Key that "the rocket's red glare, the bombs bursting in air" are now permanently recorded in our National Anthem.

British success with rockets led the armies of other nations to follow suit, making the rocket a popular

military journals" knew what they were talking about, for in World War II the rocket came back into its own with a bang (or at least a swoosh). The lightweight bazooka and its rocket projectile enabled infantrymen to knock out tanks. The U. S. Navy used rocket-launching landing craft (LSMRs) in the invasions of North Africa, Sicily, Italy, Normandy, southern France, Cape Gloucester, Kwajalein, Eniwetok, Saipan, Guam, the Palaus, the Philippines, Borneo and Okinawa.

In addition, since the rocket offered a maximum of firepower with a minimum of added weight—and no recoil—it was soon adopted for aerial armament. The first air-launched U. S. rockets were little more than adaptations of the bazooka, but by war's end Navy planes were blasting the enemy with *Tiny Tim*, an 11.75-inch rocket which weighed 1,288 pounds and had a 500-pound, semi-armorpiercing bomb for a warhead. Another important use of rockets in aviation was JATO (Jet Assisted Take-Off), which enabled heavily-loaded planes

## Brains

weapon for several decades. Then about 1850, with the adoption of rifled artillery, rockets went "out of style." By 1900 they were considered obsolete almost everywhere, and as late as 1942, the *Encyclopaedia Britannica* referred to the importance of rockets in modern warfare with these words:

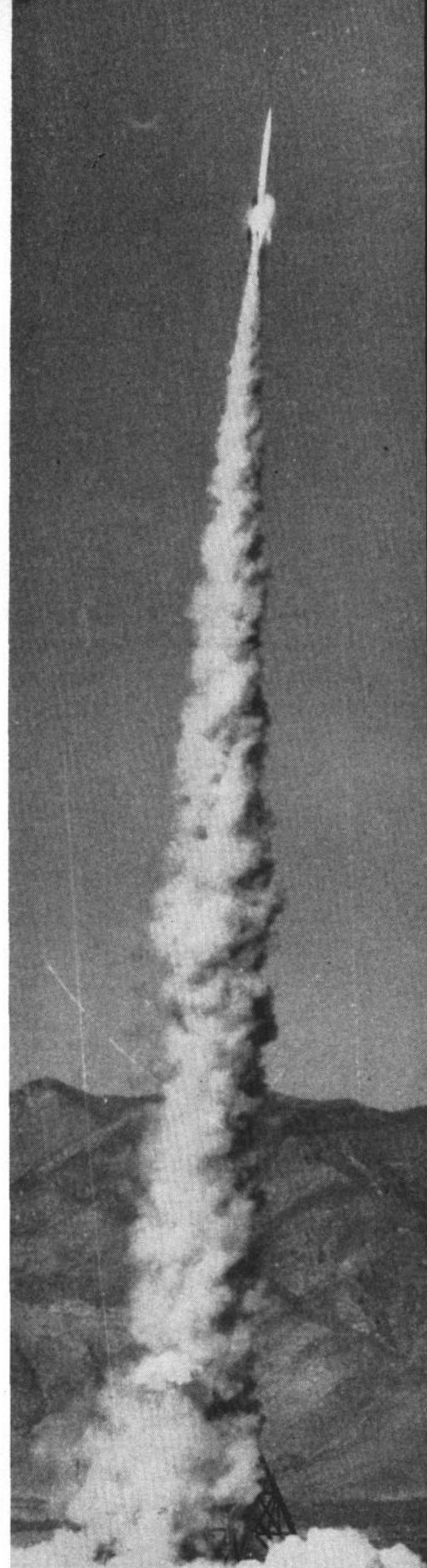
"The idea of a missile propelled on the rocket principle, however, will not down and is revived from time to time for discussion by contributors to military journals."

Evidently the "contributors to

LATEST ROCKET SHIP, the inshore fire support ship *USS Carronade* (IFS 1) looks sawed off but she is larger and has greater fire power than the LSMR.

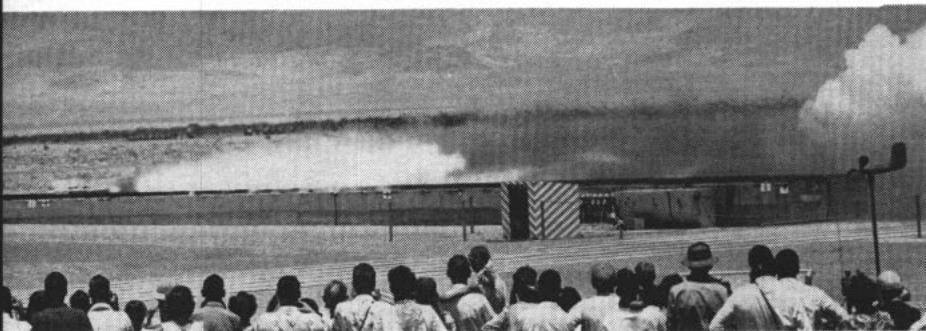


MARCH 1957





ROCKET MEN on LSMR launch their weapons against harbor installations during Korean conflict. Below: Rocket-powered sled used in aviation research.



ALL WET—Anti-sub rocket, *Weapon Able*, is uncovered and fired on board USS *Wilkinson* (DL 5). Arrow (right) points to rocket leaving its launcher.



to take off from runways much shorter than those they ordinarily required.

Ironically, though, the most devastating rocket-powered weapon of the war was one used against England, the nation which introduced rockets to Europe. This was Germany's V-2.

After the war the new field called "rocketry" more or less branched out into three different (but often overlapping) phases of study—rocket engines for guided missiles and aircraft, high-altitude research with rockets and the development of improved rocket weapons.

- In rocket engines for guided missiles and aircraft it has produced the motive power for three of our five operational guided missiles—*Sparrow*, *Terrier* and *Sidewinder*.

- In high-altitude research rockets it has launched data-gathering projectiles from ground installations, ships, planes and balloons to help unlock the secrets of the upper atmosphere and outer space. In this work the Navy has used the V-2, the *Aerobee*, *Aerobee-Hi*, *Deacon*, *Asp*, *Loki*, *Cajun*, *Viking* and various combination rockets such as *Nike-Deacon* and *Nike-Cajun*. The *Aerobee-Hi* has reached an altitude of 164 miles, the *Viking* has gone to 158 and Navy-launched V-2s have gone to about 105 miles. Among those being developed are the *Arcon*, a super-performance *Deacon*; and the *Iris*, a solid-propellant version of the *Aerobee* which should reach altitudes up to 200 miles.

In Project Vanguard, the scheduled launching of an earth satellite as part of the International Geophysical Year program, the Navy has been assigned the rocket phase.

- Since guidance and control systems are still expensive and complicated, the rocket without such systems is still an important part of the Navy's armament. Besides the LSMRs which saw action in World War II and Korea we now have the inshore fire support ship (IFS) which is larger and has more firepower than the LSMR. For anti-submarine warfare we have "*Weapon Able*," and in the air we have *Mighty Mouse*, the first successful air-to-air rocket.

That, in brief, is the story of the rocket up to now. Oddly enough, despite the rocket's 700-year history, the most important part of that story is yet to be written. —Jerry Wolff



VIKING ROCKET is towed to launching site at White Sands Proving ground.

## Navy's Viking Is a Record Breaker

**A** GIANT AMONG ROCKETS is Navy's high flying *Viking*. Blasting skyward from White Sands Proving Ground, it has soared as high as 158 miles carrying with it cameras and scientific instruments to record valuable information on the upper atmosphere. It has accomplished a long record in its brief history.

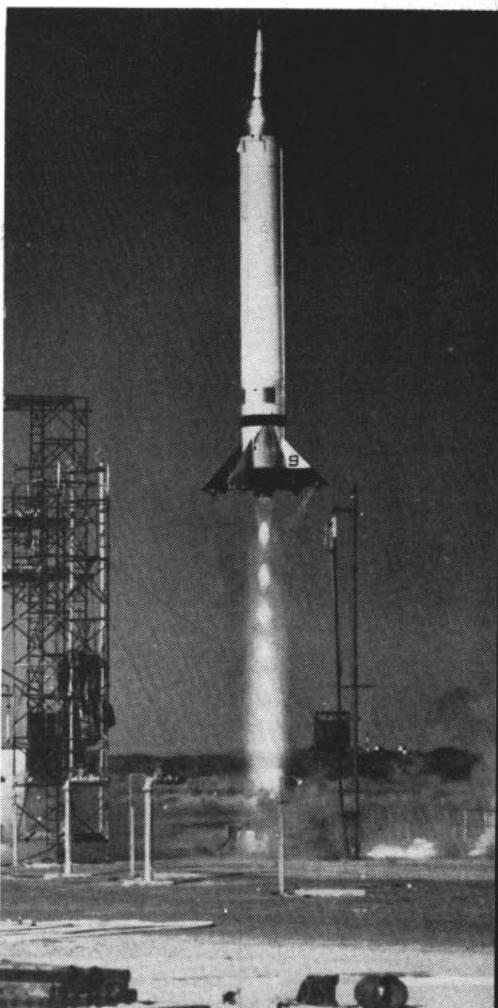
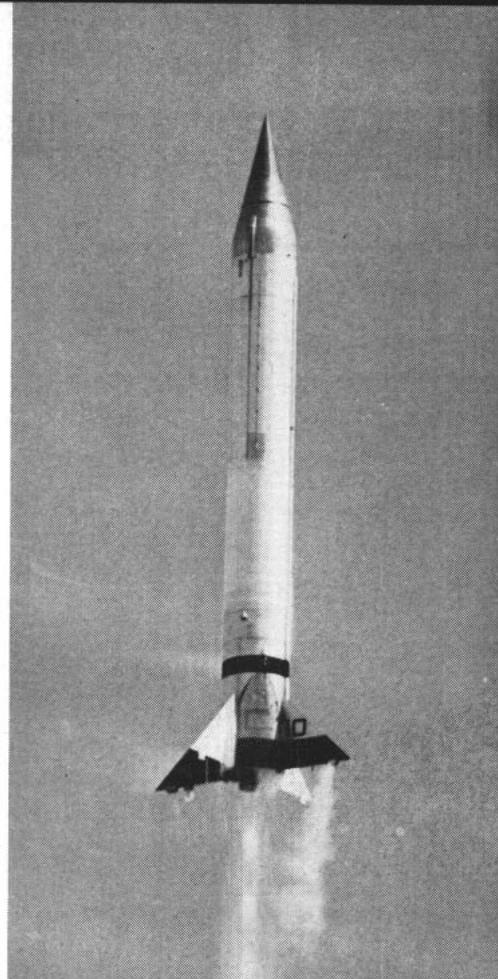
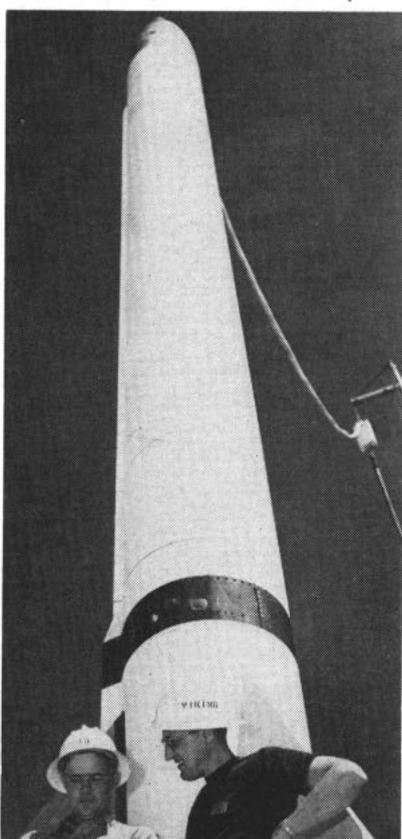
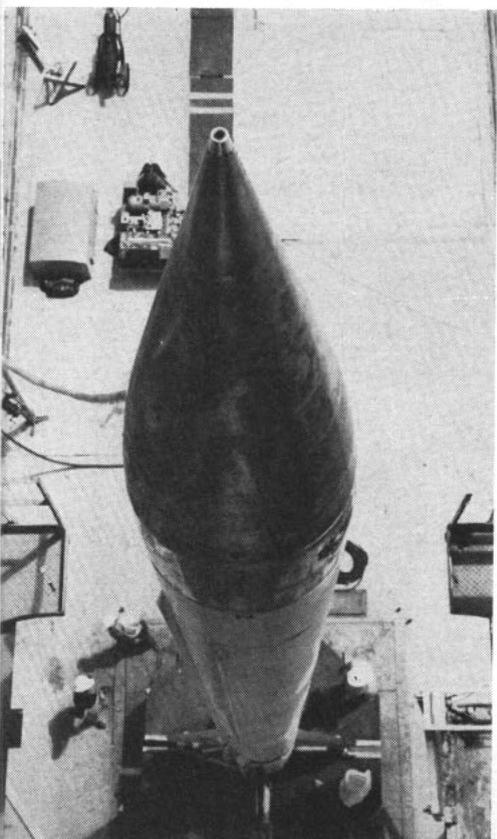
The *Viking* rocket came into being in 1946 when it was decided that rather than build a copy of the captured German V-2 it would be better to produce an entirely new

vehicle designed expressly for high-altitude research.

Although the first *Viking* only went up to little over 51 miles because of a premature motor cut-off, subsequent firings attained a new altitude record for single staged rockets, previously held by its German cousin.

A modified *Viking* will play an important part in Project *Vanguard* as the first stage of the three-stage rocket being designed to launch the earth satellite.

**ON THE UP AND UP** — Navy's high-flying rocket is readied in gantry. Far Right: *Viking* blasts away from earth reaching toward outer space.



# Birth of the Earth

Closely associated with the rocket and guided missile programs discussed on the preceding pages is the story of the man-made satellite. Here is the story and the Navy's role in it:

**S**OME TIME DURING the 18-month period beginning next July 1, a huge, three-stage rocket will take off from a point in the United States and head for "up." One of the most ambitious undertakings yet to be conceived by man, *Project Vanguard* will simply throw a small metal globe some 200 or 300 miles into space. This, and similar later efforts, will be the culmination of many contributions made by the U.S. armed forces and scientific institutions to the International Geophysical Year. (For more on IGY, see May 1956 issue of ALL HANDS, pp. 2-6.)

*Vanguard* is the name assigned to the Department of Defense portion of the earth satellite program. The program is conducted on a three-service basis with Navy management through the Chief of Naval Research. Responsibility for the technical program rests with the Naval Research Laboratory. This includes

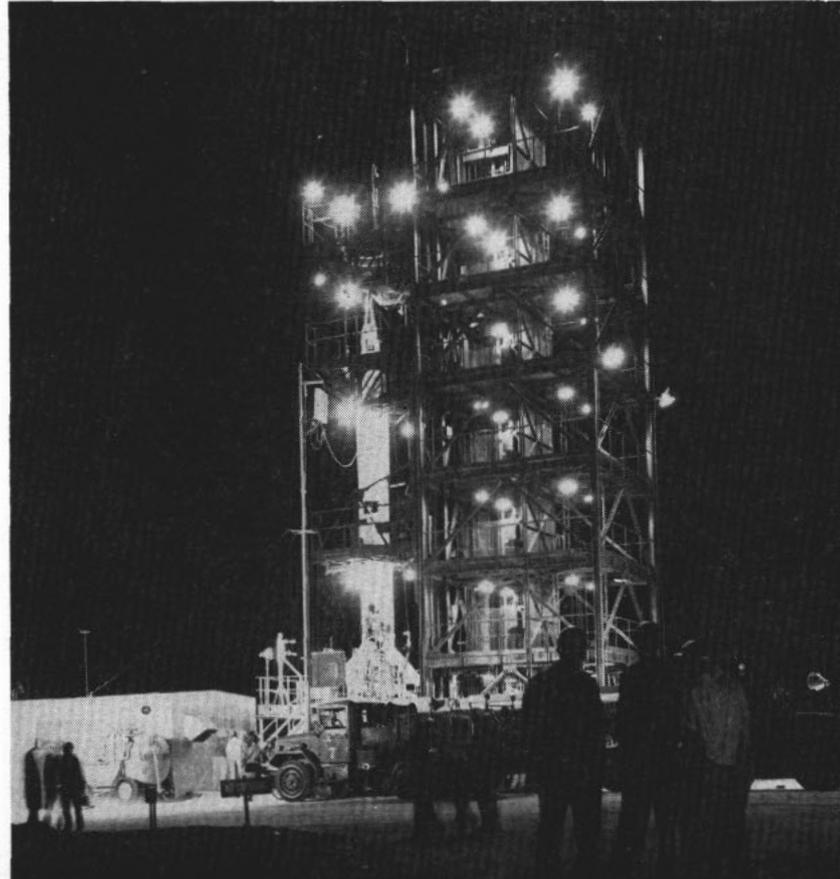
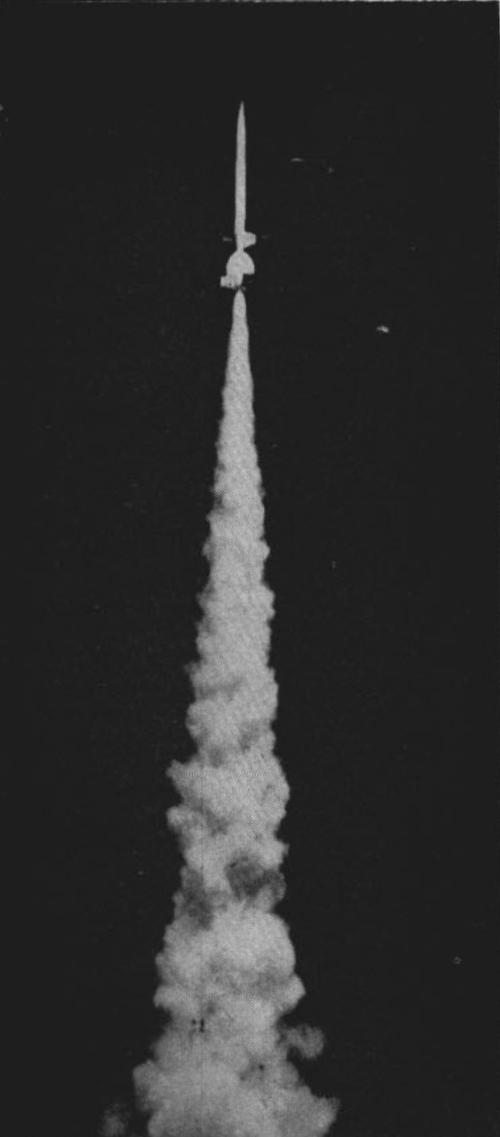
the three-stage launching vehicle, the launching, the initial radio tracking of the earth satellite and the operation of some of the tracking stations.

It is anticipated that when the globe reaches its destined height, it will be traveling about the earth at some 18,000 miles per hour, fast enough so that it will make a revolution about the earth approximately every 90 minutes. No one knows exactly how long it will stay in its orbit, nor the precise shape and altitude of the orbit, since all this will be determined by the speed, altitude and orientation of the rocket when the satellite is finally separated from it. However, so long as it maintains its orbit around the earth, it will be, literally, a miniature satellite broadcasting information about itself and its environment to observers back on earth.

What will it do? What's the point of the whole thing?

The main point is to find out what's up there besides a bunch of widely spaced nothing. Inside the shell of the satellite will be a tiny

HEAVENS ABOVE — *Viking*, shown below at Patterson AFB *Vanguard* test, and *Aerobee* (left) will take satellite up through the first and second stages.



# Satellite

"Minitrack" and telemetering transmitter, batteries, and as many scientific instruments as can be efficiently included. These will record the temperature of the satellite as it travels through space, measure the intensity of the sun's ultra-violet rays, count the number and the erosion effects of the micro-meteors striking the satellite, and reveal other secrets of the region just above the atmosphere. These data will be telemetered to a series of special high-powered receiving stations on earth.

Scientists hope to learn something about certain light waves which cannot be studied on the ground as they do not penetrate the earth's atmosphere. This should tell them more about the sun and solar physics—what makes the sun tick, how it provides energy, the effect of sun-spots in long-range communications, what makes the weather on earth so changeable, and similar problems.

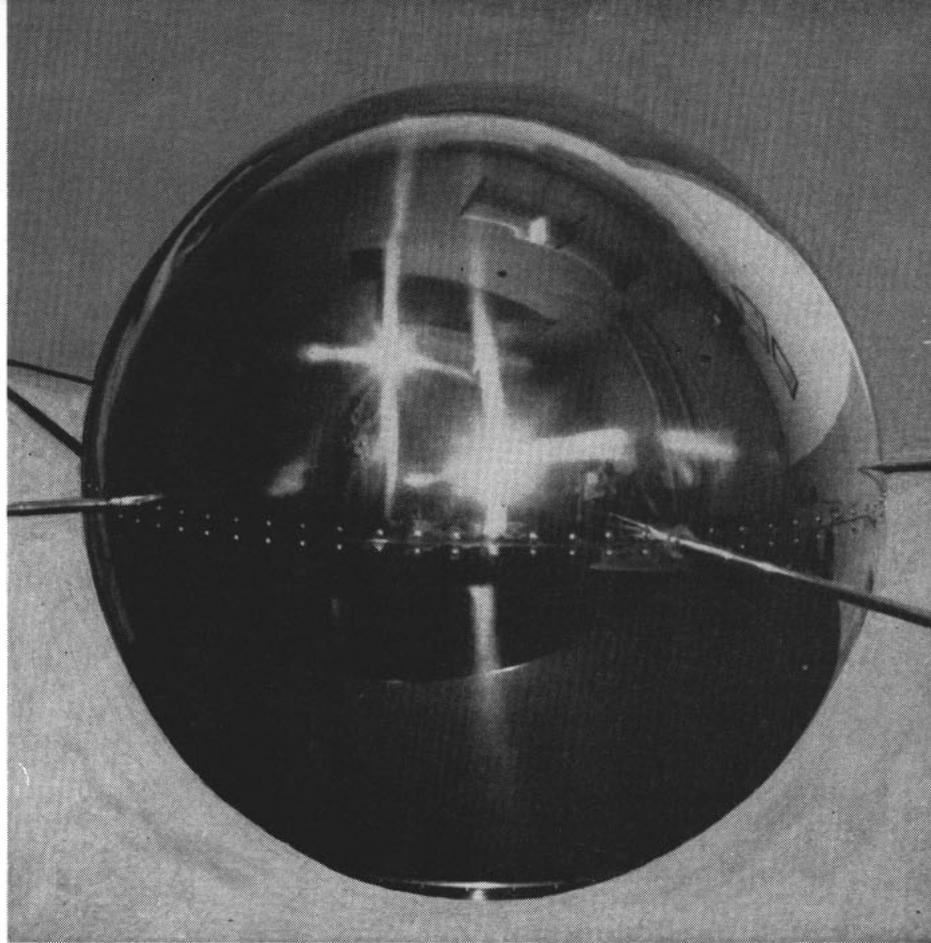
Visual plotting and radio tracking of the satellite will enable man to measure the bulge of the earth at the equator and perhaps learn many other facts about the size and shape of the earth. It will permit measurements of the uniformity of the earth's crust, and provide much more accurate data on distances, permitting more accurate mapping.

The Buck Rogers contingent also hopes to learn a lot about meteors—among other things, whether or not it would be safe to launch large manned satellites farther out into space.

After the first satellite is successfully launched, later ones may carry other types of instruments for additional data. It is hoped to learn more about cosmic rays, the earth's magnetic field, and other data about astrophysics—the physics of the universe.

When it takes off, the 21.5-pound ball, which will be approximately 20 inches in diameter, will be carried by an 11-ton 72-foot-long, finless three-stage launching rocket. The first stage of the rocket, which is about two-thirds of the entire assembly, will push up to about 35 miles in something over two minutes.

This first stage will be a modified and improved version of the earlier *Viking* rocket. It will have no fins, since the rocket's direction will be



'MOON SHINE' — Full scale model of earth satellite made by Naval Research Laboratory has shiny thin skin made of two hemispheres of polished aluminum.

adequately controlled by tilting its motor. The motor is mounted in a gimbal bearing which permits varying the direction of thrust by several degrees from the center line of the rocket.

Three gyroscopes will be the heart of the reference system that provides steering "instructions" to the autopilot.

This motor will produce 27,000 pounds of thrust, and will operate for about 140 seconds. The propellants will be liquid oxygen and kerosene. They will be forced into the combustion chamber by turbopumps powered by the decomposition of hydrogen peroxide.

The second stage, liquid-propellant motor will be fueled by white fuming nitric acid and unsymmetrical dimethyl-hydrazine. They will be forced into the combustion chamber under pressure. The third stage, which will carry the satellite, will be a solid-propellant rocket motor.

The third stage, carrying the satellite on its nose, must be projected into its final position with great precision, in order to establish an orbit that will not appreciably intercept

the earth's atmosphere. The friction of the earth's denser atmosphere would cause the satellite to lose its energy too rapidly and fall prematurely toward earth.

The total flight path will follow, roughly, a vertical ascent for a short period after launching, then a gradual inclination toward the horizontal. The first-stage rocket will burn out and drop off at 30 to 40 miles' altitude when a velocity of 3000 to 4000 miles per hour is reached. The second rocket will burn out at about 140 miles' altitude and about 11,000 mph, and coast under its own momentum to an altitude of about 300 miles. At this altitude the third motor will fire and accelerate the satellite vehicle to its orbital velocity, about 18,000 mph.

Once established in its orbit, the satellite must be tracked. Most scientists agree that optical tracking, through the use of instruments such as the photo-theodolite, will work but that the satellite is difficult to spot unless the observer knows the orbit's predicted position. At best, the satellite will be visible, to optical devices, only during the few



**HOW TO MAKE A SATELLITE** — NRL machinists work aluminum blank into shape for the satellite's skin.

hours after sunset and before sunrise, assuming that weather conditions permit visibility and that the observer has previous knowledge of when the satellite will pass within optical range.

Because of these drawbacks, a more reliable method of tracking has been developed at the Naval Research Laboratory. Known as "Mini-track," this method uses a miniature radio transmitter in the satellite which radiates a continuous signal to sensitive receiving equipment on the ground. This method also aids optical tracking, by furnishing estimated satellite position predictions, but requires a line of observing stations

to intercept the satellite on its orbit, in fair weather or foul, any hour of the day or night. The satellite is expected to make one revolution around the earth approximately every 90 minutes.

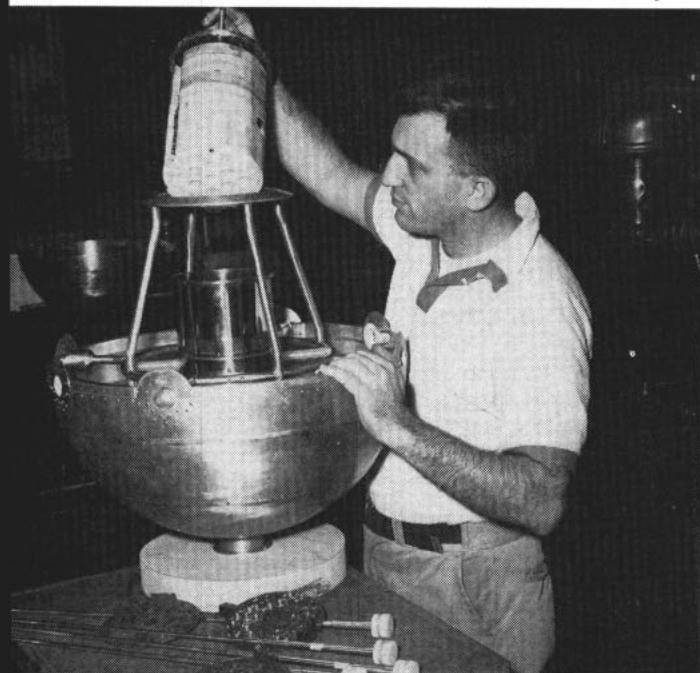
As suggested earlier, *Vanguard* is one of the most ambitious projects ever to be undertaken. It is an attempt to probe the fringe of outer space, so necessary before man himself can hope to attempt the big jump. The effort raises innumerable problems which must be answered before this first satellite can be launched.

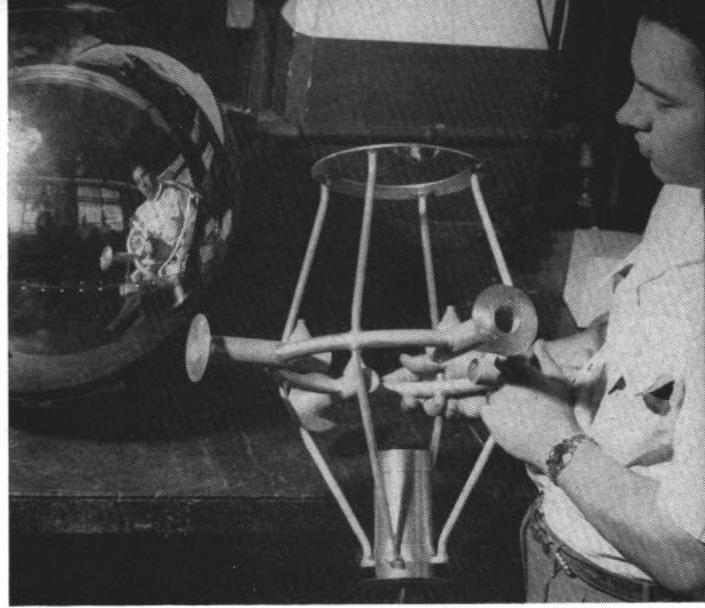
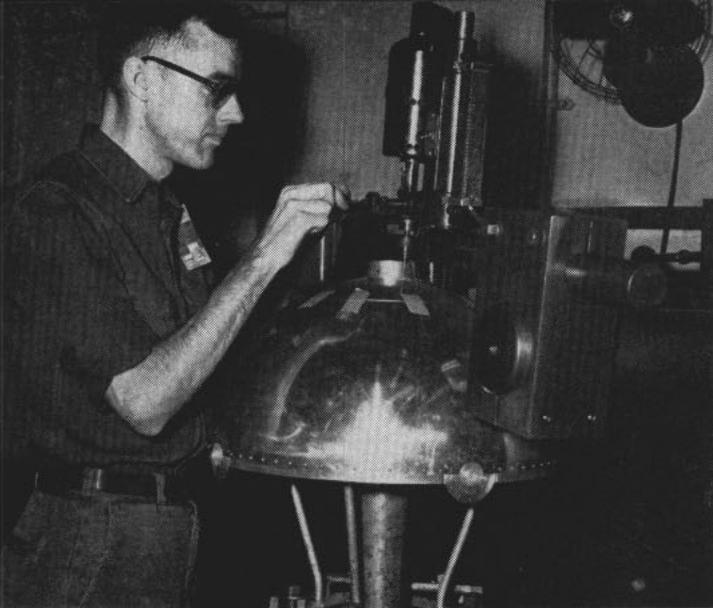
The satellite itself must be sufficiently large to permit optical track-

ing and to carry scientific instruments, and yet be light—every ounce is important. Yet the design must be sufficiently sturdy to protect the scientific devices inside against the high accelerations and vibrations encountered on the ascent, and to survive after release from the third-stage rocket vehicle—to withstand the extremes of temperature in its orbit, as well as to resist the pitting action of micro meteorites—so-called meteor "dust."

The amount and kind of instruments to be included in this first satellite are other areas in which problems must be solved and compromises agreed upon. Subject to

**INSIDE STORY** — Plastic foam encased electron package is put into gold plated housing and 'lid' is attached.





HOLES ARE DRILLED in finished half of the sphere. Right: Supporting inner structure is readied for installing.

weight and space restrictions, enough instruments must be sent aloft to do as much scientific work as is possible. *Vanguard's* job is to put into an orbit an object capable of doing work of importance to as many scientific fields as possible.

The first satellite cannot completely satisfy the men in each field—it cannot do all the things they would like to see done. The *Vanguard* technical program must result in a satellite that will be workable, yet scientifically useful.

On the technical side, this means sacrifices in terms of accepting a certain minimum size and weight, with resultant engineering problems.

On the scientific side, it means sacrifice in terms of the useful payload which the first satellite will carry. A fraction of its weight—perhaps one-fourth—will consist of scientific research instrumentation and its power supply. The remainder will be devoted to structure, a tracking transmitter, power supply, and possibly turn-on equipment.

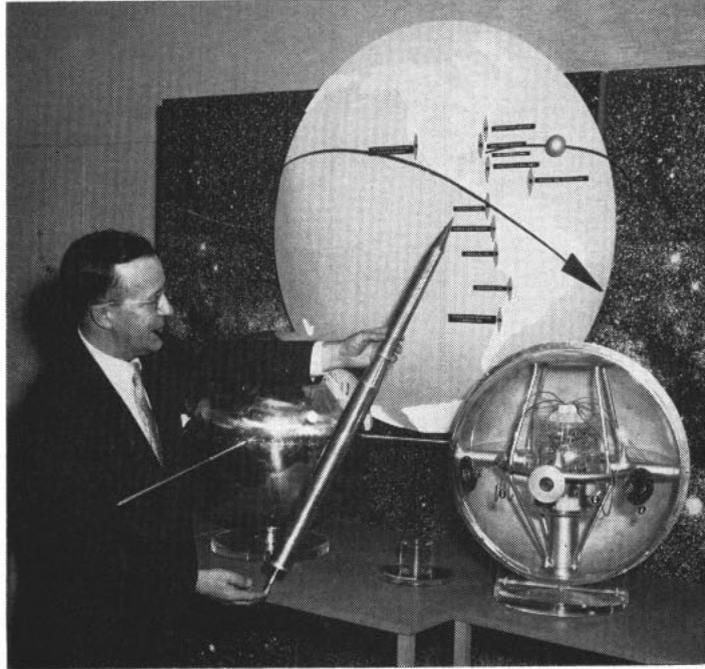
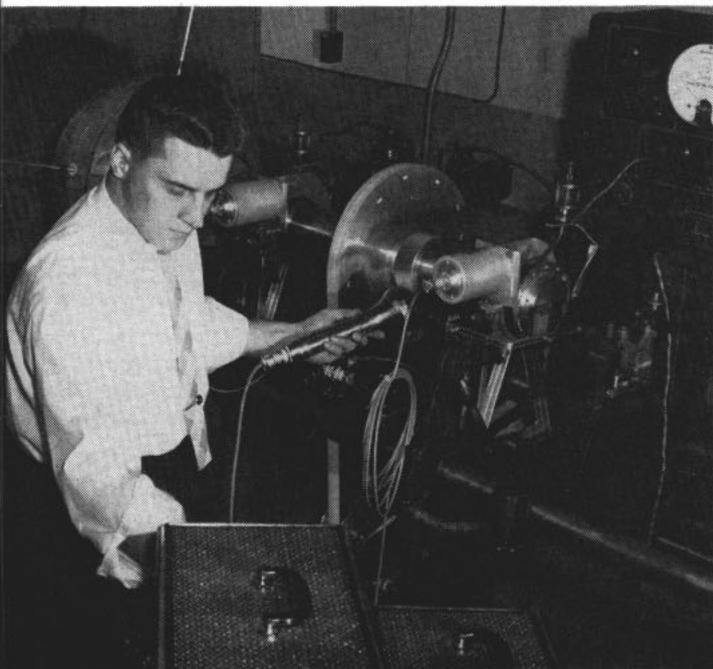
Several rockets will be built in connection with the program because, to be reasonably certain of successfully putting a satellite into an orbit, we must have more than one shot available in our locker.

If only one attempt were to be made, the chances of failure would

be greatly increased. This is a field that places great demands upon everyone's knowledge and calculations of probable performance. Much money is involved. If all of this money and all of this effort were risked on one shot, everyone concerned would always be faced with the desire to make one more calculation, one more adjustment or one more test flight before firing, in order to be more certain of success. In such circumstances, *Vanguard* might never get off the ground.

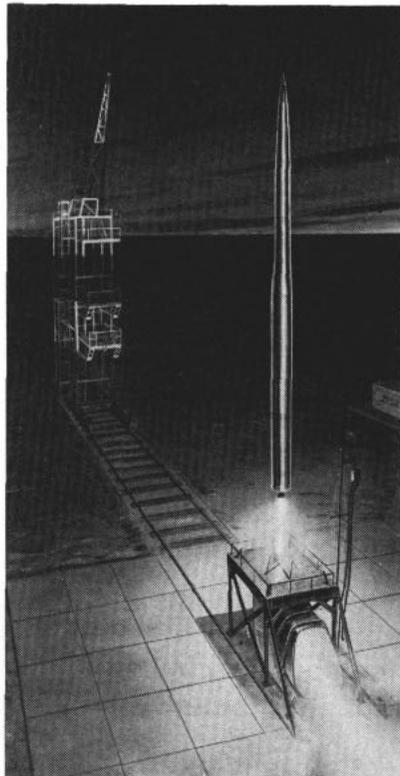
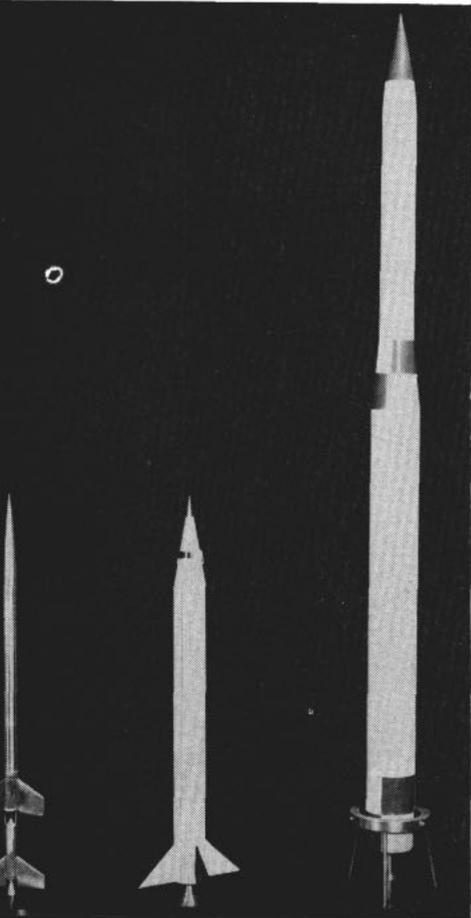
To complete the job on time, every step of the program must be marked by bold, confident engineering in which we are prepared to take the

BALANCE, spin is tested by ENS A. Simkovich. Rt: Dr. J. P. Hagen, director of *Vanguard*, demonstrates orbit.





NAVAL RESEARCH LABORATORY engineer adjusts tiny info-collecting device. Below: Aerobee, Viking and Vanguard rockets. Rt: Drawing depicts launching.



consequences of falling short of perfection.

Determination of specifications for the launching rocket and the satellite, and their construction, represent major phases of the technical program for *Project Vanguard*. The project director must be equally concerned, however, with the related programs.

As soon as the project was established, Navy scientists and facilities officers began a series of consultations with their Army and Air Force counterparts to determine the best launching site, the requirement for logistic support and how they will be met by the three services, and how problems of establishing and manning tracking stations will be handled. A launching site has been selected. The satellite will be launched by the Navy from the Air Force Missile Test Center at Patrick Air Force Base, near Cocoa, Fla.

Scientists are now working to determine the primary orbit of the satellite and the specific tracking methods. Both optical and radio tracking will be used. Time, speed and position information from many separate sightings at different tracking stations must be fed rapidly into a central electronic computer, which will determine the orbit on the basis of this information. Data on the orbit must then be broadcast quickly throughout the world to enable scientists of the IGY to pick up the satellite with little difficulty.

*(If you are at the right place at the right time, and know where to look, you will be able to see the satellite yourself. For the past several years, scientists have been conducting studies on the visibility of stars at night and during the day. Calculations were made on the conditions under which small earth satellites might be seen. For purposes of this study, the scientists assumed a satellite that was a 21-inch sphere traveling in an equatorial orbit at an altitude of from 200 to 1000 miles. As a result of these studies, "it has been concluded that if one knows exactly where and when to look, a satellite when nearly directly overhead and at 200 miles altitude would first be visible through 7 x 50 binoculars when the sun is 2° below the horizon, and would be visible to the naked eye for solar depression angles greater than 9°. To see such a satellite easily, however, and to be sure of observing it, when the position is*

**ALL HANDS**

not known exactly, some telescopic magnification, such as 7x50 binoculars would almost be a necessity and observations of the satellite should not be attempted until the sun is 5° below the horizon.”)

When the rocket and its satellite payload are ready to launch, and all of the launching facilities and tracking equipment and stations are in readiness, the launch vehicle will fire the satellite up into its orbit.

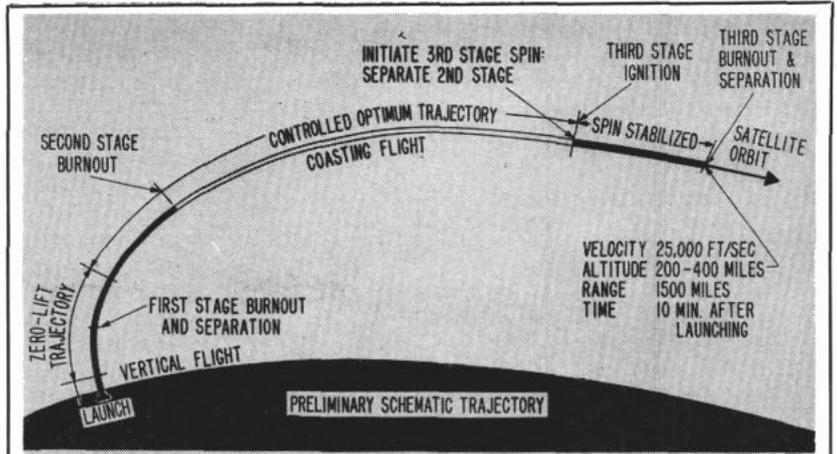
The satellite's orbit probably will be elliptical, rather than circular. The point of nearest approach (the perigee) will be about 200 to 300 miles from the earth, and apogee—the most distant point in the orbit—will be from 800 to 1500 miles out.

The problem of guidance, to ensure that the satellite is projected horizontally into its orbit, is especially difficult. If the angle of projection is too high or too low, perigee will be too close to the earth and the satellite will dip into the denser portions of the atmosphere and disintegrate before it has made enough revolutions to be of any value. The angle of projection should not deviate by more than a few degrees from the horizontal for a launching altitude of 300 miles.

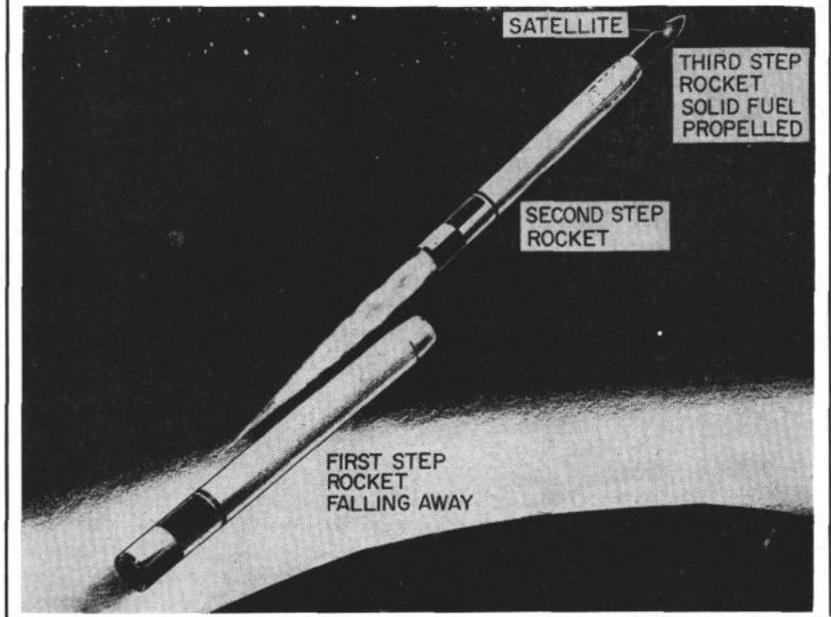
If it misses by more than this, the perigee altitude will be roughly half of the launching height, which would cause the satellite to dip well into the denser parts of the atmosphere and cut short its life. The guidance system must therefore be designed to ensure an error of no more than a few degrees in the angle of projection into the orbit.

The consequences of missing the planned orbit, which are fairly serious in terms of the satellite's lifetime, would also pose difficult problems of tracking. The satellite will “transit” different areas of the earth on each revolution. If a revolution is completed in 90 minutes, as it is now contemplated, the earth will have completed roughly one-eighteenth of its daily rotation during this time, so that the satellite will appear at a different longitude for the same latitude on its next trip.

Although the portion of the atmosphere through which the orbit will pass is extremely thin (just how thin is one of the facts that the satellite may establish), the cumulative effect of the drag of this thin air will be enough to bring the satellite gradually closer to the earth. As the



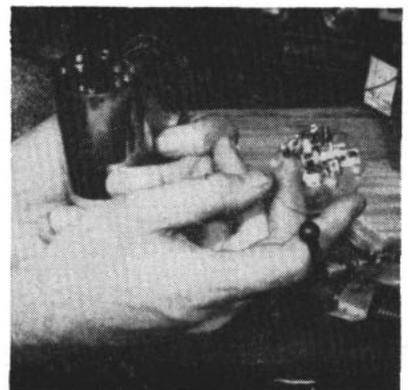
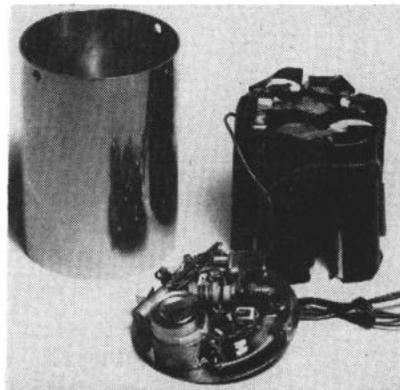
UP IN THE AIR — Diagram above shows stages and path of rockets carrying satellite to orbit. Below: Drawing shows three-stage launching rocket.



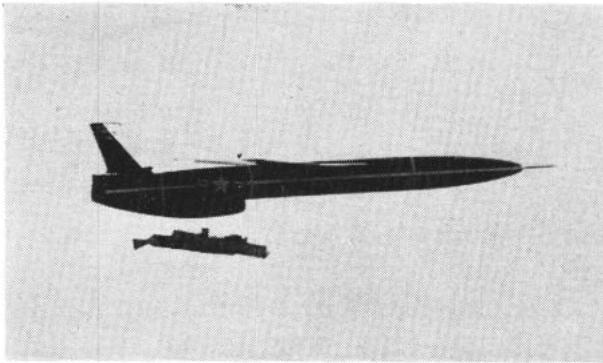
satellite enters the denser atmosphere, it is expected to disintegrate harmlessly in the same manner as a meteorite, because of intense heat and probable mechanical collapse.

The lifetime may be several days, or weeks, months, or even years, depending upon what is up there and upon the degree of precision attained in the launching.

MINITRACK TRANSMITTER will send signals from the earth satellite to tracking stations on the ground. Transmitter was designed at Naval Research Lab.



Brief news items about other branches of the armed services.



'OFF IT GOES' — The Air Force's long-range strategic guided missile, SM-62 Snark, takes off on a test flight.

★ ★ ★

IN THUMBING THROUGH this special issue of ALL HANDS, you may get the impression we are suggesting that only the Navy is using guided missiles. Not at all. We've emphasized Navy guided missiles because this publication is written primarily for naval personnel. However, make no mistake, the Army and Air Force are equally active.

Here's a brief unclassified rundown on their guided missile arsenal:

★ ★ ★

## ARMY

ON 16 APR 1946, the first American-fired V-2 rocket was shot into the air above the New Mexico desert at the Army's White Sands Proving Ground to conduct research in the field of rockets and guided missiles. By February 1949, Army scientists had combined the V-2 rocket and an experimental liquid fuel, high-altitude rocket known as the WAC *Corporal*. This two-stage rocket, nicknamed *Bumper* attained the highest altitude ever reached by any man-made object—250 miles up and traveling at a speed of 5000 miles an hour.

FOR THE BIRDMEN—Supersonic *Falcon* guided missile for USAF interceptor pilots can down maneuvering bombers.



Further developments by the Army include: *Nike*, named after the Greek goddess of victory, which is the Army's first supersonic anti-aircraft guided missile designed to intercept and destroy the enemy target regardless of evasive action. *Nike* guided missile installations are now spread throughout the United States as an inner ring of defense for industrial, highly populated and strategic areas. *Nike* is a liquid-fueled supersonic anti-aircraft missile about 20 feet long and about one foot in diameter, with two sets of fins for guidance and steering. The missile and booster weigh more than one ton.

Speed, range, altitude and lethality of *Nike* are classified. Fired from an almost vertical position, *Nike* can meet an attack from any direction. There are eight launchers in each *Nike* battery, which is operated by a crew of approximately 100 men. Personnel are trained at the Anti-aircraft and Guided Missile School, Fort Bliss, Texas.

The improved *Nike B* is capable of dealing with high performance aircraft.

*Corporal*, equipped with either an atomic or conventional type warhead, is capable of engaging targets far beyond the ranges of artillery or the new 280mm gun.

The weapon gives the field commander great firepower on the battlefield and enables him to strike selected targets deep in enemy rear areas. *Corporal* follows a ballistic trajectory in its flight to the target. Weather and visibility conditions place no restriction on the use of the weapon. Motive power is supplied by a powerful rocket motor. The missile travels through space at several times the speed of sound. A *Corporal* battalion has 250 men. Each battalion has two batteries—a firing battery and a service battery. There are three launchers to a battalion. *Corporal* battalions have been stationed in Europe.

*Redstone Missile* is another in the Army family. The first U. S. Army unit to fire the Army's *Redstone* missile was announced in March 1956. The Army uses surface-to-surface artillery missile units armed with *Redstone* and other Army missiles to extend and supplement the range and firepower of artillery cannon. *Redstone* is the largest surface-to-surface ballistic guided missile successfully fired in this country. It is named for the place of its development, the Army's Redstone Arsenal at Huntsville, Ala.

Among the latest additions to the Army's arsenal are the *Lacrosse*, surface-to-surface guided missile, and *Dart*, an antitank guided missile.

These represent the better known guided missiles, but by no means give the whole picture of Army missile development.

★ ★ ★

## AIR FORCE

*Matador* (TM-61A), a tactical missile of subsonic speed, received its first flight in December 1950. It has a wingspan of 28.7 feet, length of 39.6 feet. Ground-launched by a rocket booster from a roadable launcher, it is powered by a jet engine (J-33-A-37), controlled electronically in flight by ground personnel, and is capable of delivering conventional or nuclear weapons

several hundred miles. *Matador* squadrons are already stationed in Germany and Orlando, Florida. A later version, the TM-61B, is longer and faster and has greater range and improved guidance system. It has been tested in successful launching at Holloman Air Development Center, New Mexico.

*Falcon* (GAR-1) is a guided aircraft rocket of supersonic speed under development since 1947; it was test-fired in 1951. Production was ordered in 1955 and it became operational in March, 1956. *Falcon*, which weighs slightly over 100 pounds and is approximately six feet long, is powered by solid rocket propellant and electronically fired and guided. Designed for under wing or pod installations, it can be carried in quantity by interceptor aircraft, launched miles from target, and automatically "home" on target. During its test period, it knocked down target planes without carrying explosive warhead.

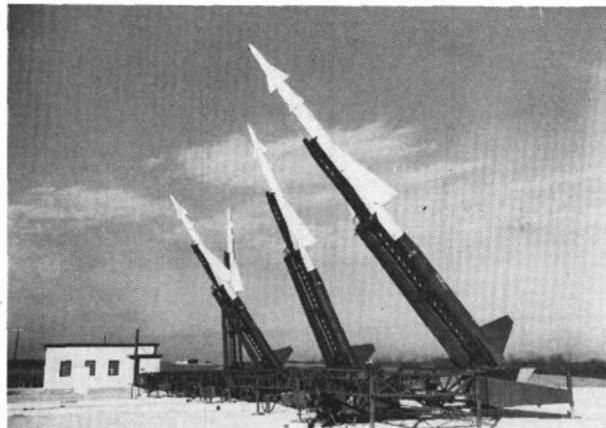
*Snark* (SM-62), a long-range strategic missile, is a winged pilotless bomber powered by a turbo-jet engine, and is the first U. S. long-range missile to be test-flown. It is considered to have range, accuracy and load-carrying capabilities as good as ballistic missile types.

*Navaho* (SM-64), another long-range strategic missile, is rocket-launched and air-breathing. It is considered to have range, accuracy and load carrying capabilities as good as ballistic missile types.

*Rascal* (GAM-63), a long-range guided missile, is a rocket-powered pilotless bomber designed to be carried by strategic bombers and released miles from its objective to proceed at high speed to target.

*Bomarc* (IM-99) is a long-range interceptor guided missile of supersonic speed. Successful experimental launchings at Patrick Air Force Base are now a regular part of the development program. A pilotless guided missile, it is launched from the ground and designed to seek out and destroy enemy aircraft at great distances from its launching site.

*Intercontinental Ballistic Missiles*, including the *Atlas* and *Titan* ICBM, are now under development. Many of the major components and sub-systems are similar for the ICBM-IRBM. This is expected to accelerate their development and greatly reduce the overall cost of the ICBM-IRBM program.



**NIKE WATCH DOGS**—Nike guided missile batteries help protect cities and coast of U.S. from enemy air attack.

From the above you can see the importance of the guided as a weapon in each of the armed services. And, as is the case with Navy guided missiles, this is only part of the story of guided missile development in the Army and Air Force.

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AIR RESEARCH AND DEVELOPMENT COMMAND engineers have created a man-made "brain"—a computing device which, in the language of electronics, has a memory of 4096 words of 48 "bit" capacity.

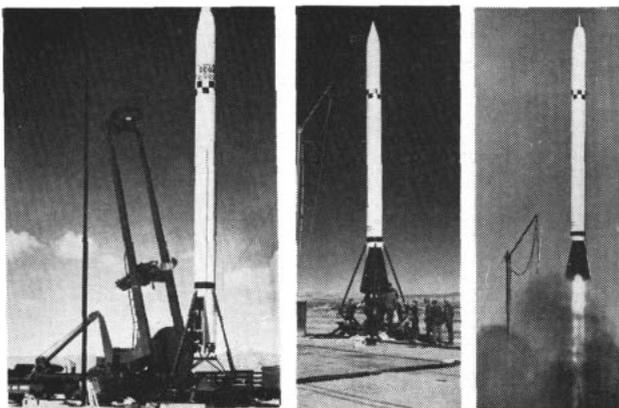
Known as FLAC (Florida Automatic Computer), it analyzes large quantities of missile flight test data in a small fraction of the time formerly required.

Dubbed "Mr. Genius" by its creators after five years of development work, the machine has one of the largest single magnetic core memories of any computing device in use today.

FLAC was developed to fill the Air Force Missile Test Center's need for an extremely versatile computer which could assimilate large amounts of varying types of information at high speed and answer quickly.

An unusual punch-paper tape type of reading device in the computer has been developed. The tape enables reading of up to 300 characters per second by the computer. Six hundred characters are expected when development work is completed.

**KING-SIZE** fire support for soldiers is furnished by Army's *Corporal*, surface-to-surface, guided missile.





NAVY GUIDED MISSILE students take a practical approach while learning about what goes on inside a missile.

## Schools and Courses for Missileers

**H**ERE'S A RUNDOWN of the various schools that provide instruction in the operation, maintenance and repair of ship-launched guided missiles and associated test equipment. Instruction for both officers and enlisted personnel is provided.

All requests for quotas to these schools should be directed via the chain of command to the Chief of Naval Personnel with the exception of the *Regulus* Propulsion, Class "C" Course, which should be directed to ComServLant or ComServPac as appropriate.

*Courses conducted at the U.S. Naval Guided Missiles School, Fleet*

**NAVYMEN STUDYING** ship-launched missiles receive instructions on the wing folding operation of *Regulus*, surface-to-surface guided missile.

*Air Defense Training Center, Dam Neck, Virginia Beach, Va., are:*

- **GUIDED MISSILEMAN — CLASS "A"** — (24 weeks). This course covers such areas as: mathematics applicable to electricity, electronics and guided missiles; laboratory and classroom work in physics pertaining to aerodynamics, hydraulics, gases, forces and motion; laboratory and classroom work in basic electricity and electronics; special electronic circuits applicable to guided missile control and guidance; hydraulics applicable to guided missile internal control; practical work in troubleshooting and maintenance of guided

missiles and test sets; practical experience in testing and preparing surface-launched missiles for flight, and general safety precautions.

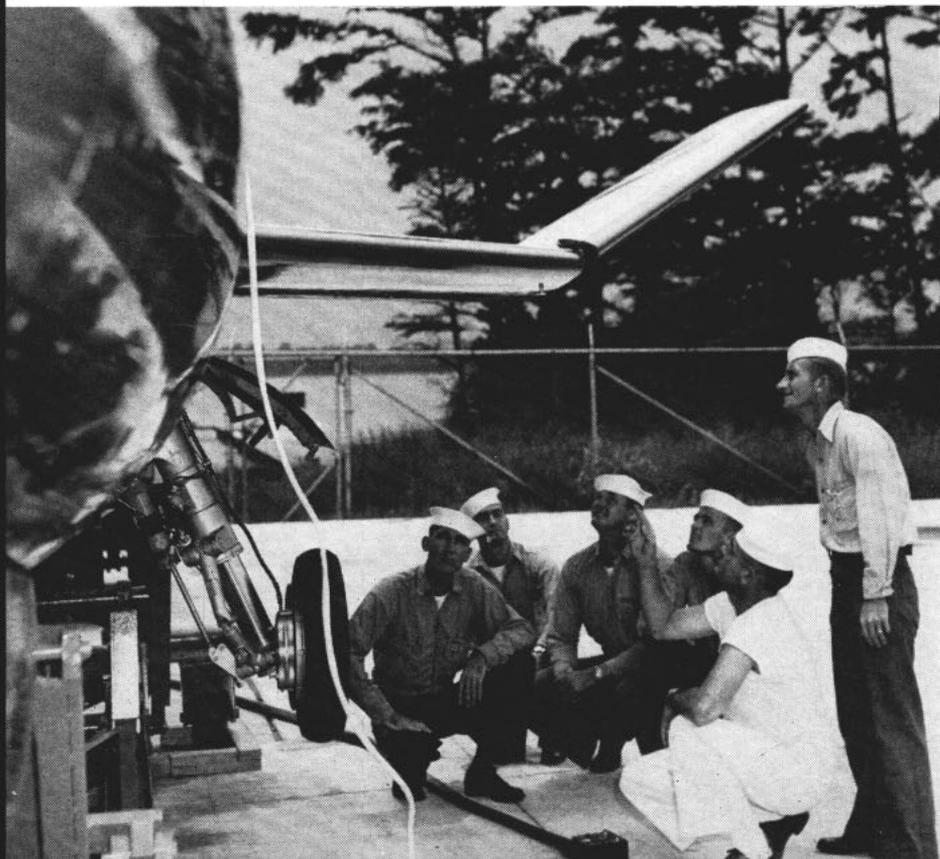
*Personnel Eligible* — SA and SN, Regular or Reserve, having normal color perception, normal hearing and qualified for sea duty. Must be on active duty with three years' obligated service and scheduled for assignment as guided missileman strikers. Secret clearance required. Combined ARI and MECH scores must be at least 110.

Upon successfully completing the 24-week class "A" course, students will automatically be enrolled in either the *Regulus* GS Class "C" or *Terrier* GS Class "C" course.

- **REGULUS GS—CLASS "C"**—(12 weeks). This course provides instruction regarding testing, alignment, adjustment, replacement and repair of the internal guidance and control components of the *Regulus* missile and its test equipment. It also covers handling, stowage, test and preparation of *Regulus* sections and components, associated test equipment; handling and launching equipment; safety precautions; records and reports.

*Personnel Eligible* — Graduates of the Guided Missileman, Class "A" Course; GS convertees upon completion of basic electronics training and other petty officers of the GS rating. Must be on active duty with 18 months' voluntary obligated service, and be assigned or scheduled for assignment to *Regulus* guided missile billets. Secret clearance required.

- **TERRIER GS — CLASS "C"** — (12 weeks). The scope for this course is the same as for the *Regulus*, Class "C" School outlined above, except



that it deals with the *Terrier* missile.

**Personnel Eligible** — The same as for *Regulus* Class "C" School except that personnel will be assigned or scheduled for assignment to a *Terrier* missile billet.

• **REGULUS ORDNANCE AND PROPULSION—CLASS "C"**—(12 weeks). Covers a wide range of subjects in connection with missile propulsion system and launching. It covers in detail: configuration, characteristics, capabilities and employment of the various surface-launched guided missiles and associated equipment; operation, maintenance and repair of *Regulus* handling and launching equipment, propulsion system and accessories, and structural components; handling, stowage, assembly, test, alignment, adjustment, replacement and, where applicable, repair of *Regulus* propulsion system and accessories, explosive and structural components, and hydraulic/pneumatic systems not associated with missile internal guidance and control; and safety precautions.

**Personnel Eligible** — All Regular or Reserve petty officers of GM, EN, TM(SS), AD and EN(SS) ratings, who have normal color perception, normal hearing and are qualified for sea duty. Must have 18 months' obligated service, and be scheduled for assignment to or assigned to a *Regulus* ordnance and propulsion billet. Secret clearance required. Combined ARI and MECH score must be at least 100.

• **SURFACE-TO-SURFACE MISSILES** — (Officers) — (12 weeks). Configuration, characteristics, capabilities and employment of the various surface-launched guided missiles; surface-to-surface guided missiles familiarization, components, test and associated equipment; test, alignment, adjustment and replacement of surface-to-surface guided missiles internal components and test equipment; maintenance and repair problems and procedures for surface-to-surface components, test and other associated equipment; handling, stowage, test and preparation of surface-to-surface guided missiles sections and components.

**Personnel Eligible** — All officers on active duty with the rank of LCDR and below having 1100, 1710, 1750 and 1300 designators, who are scheduled for assignment or assigned to SSM billets. Secret clearance required. Previous electronics experience or training essential.

• **GUIDED MISSILE INDOCTRINATION** — (Officers) — (one week). Configuration, characteristics, capabilities and employment of the various surface-launched guided missiles and associated equipment; guided missile systems, installations, organizations, operations, logistics and safety precautions.

**Personnel Eligible** — All officers on active duty who are scheduled for assignment or assigned to administrative, planning or control billets concerned with surface-launched guided missiles. Secret clearance required.

**Courses available at the U.S. Naval Guided Missiles School, Pomona, Calif., are:**

• **SURFACE-TO-AIR MISSILES** — (Officers) — (12 weeks). This course is similar to the officers' surface-to-surface missile course outlined above but deals with the *Terrier* and other SAM missiles.

**Personnel Eligible** — All officers on active duty with the rank of LCDR and below having 1100, 1710, 1750 and 7660 designators, who are scheduled for assignment or assigned to SAM missile billets.

• **GUIDED MISSILES INDOCTRINATION** — (Officers) — (two weeks). The courses and eligibility requirements are identical to those given at U.S. Naval Guided Missiles School at Dam Neck, Va., except for being a two-week course instead of one.

• **TERRIER GS—CLASS "C"**—(Enlisted) — (12 weeks). The same courses and eligibility requirements as outlined above for the *Terrier* Class "C" School at Dam Neck, Va.

**THE NAVY CURRENTLY** conducts three courses for officers and enlisted personnel who work with or are slated for assignment to billets in connection with AIR-LAUNCHED GUIDED MISSILES.

These schools include the Basic Class "A" Aviation Guided Missilemen School maintained by the Chief of Naval Air Technical Training, NAS, Memphis, Tenn., and the Class "O" and "C" Air Launched Guided Missile (General) Maintenance Courses, both conducted at the Naval Air Weapons Systems School, Naval Air Technical Training Center, NAS., Jacksonville, Fla.

All requests for enlisted quotas for the Class "A" and "C" schools should be directed via the chain of command to the Chief of Naval Personnel (Attn: Pers B2132) while quotas for the officer's course should be directed to CNO (OP541).

Here's a resume of these schools and the eligibility requirements:

• **CLASS "A" BASIC AVIATION GUIDED MISSILEMAN SCHOOL**—(Enlisted)—24 weeks.

This basic course leads to the fulfillment of the technical requirements for Aviation Guided Missileman Third Class. The training, while

KEEPING UP with the times, Navy aviation ordnancemen have the word passed to them on the *Sparrow* guided missile that will arm their squadron's fighters.





**PASSING THE WORD**—Naval Reserve officers are keeping up with Navy's missiles through orientation course at NOL, White Oak, Md.

### Reservists Study Guided Missiles

Reserve officers on inactive duty are staying on top of guided missile developments through specialized training courses offered in various parts of the country.

A course in *Guided Missile Orientation* is now underway at the Naval Ordnance Laboratory, as part of the Naval Reserve Officers School program.

The course, which is classified "confidential," includes aerodynamics, propulsion, guidance methods, principles of ballistics missiles and the tactical employment of guided missiles.

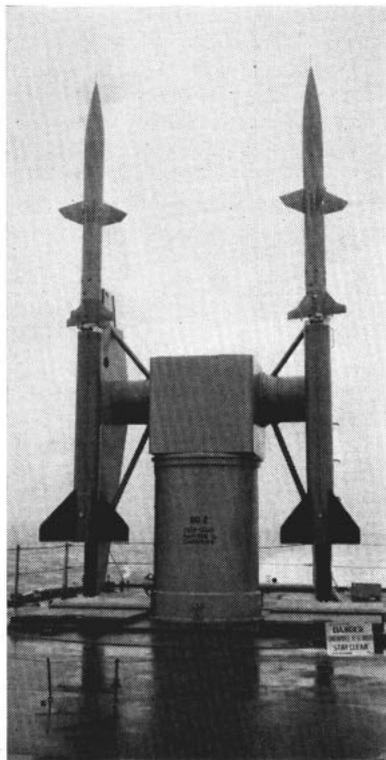
Among the individual missiles under study are *Regulus*, *Talos*, *Sidewinder*, *Tartar* and *Terrier*. Missile installations in such ships as *uss Galveston* (CLG 93), now being converted to a guided missile ship, and *uss Canberra* (CAG 2) are also part of the guided missile curriculum.

The course is serving as a "pilot" for courses to be offered in the NROS program starting in the 1957-58 school year. NROS courses provide college-level training in both general and technical subjects.

Most courses are divided into two semesters of 20 drills each.

The Bureau of Ordnance also offers guided missile training to qualified Reserve officers during active duty for training periods.

BuOrd courses include *Guided Missile Indoctrination*, a two-week course given at the Guided Missile School, Pomona, Calif., a similar course of one week's duration at Dam Neck, Va., and the two-week BuOrd Guided Missile Course, Washington, D. C.



**RESERVE MISSILE** course includes study of GM installations on ship.

directed primarily at the technical qualifications for GF3, also covers the minimum factors required for advancement to GF2.

This six-month course provides training in connection with the fundamentals of electronics; MHF, VHF, and UHF transmitter theory; radar fundamentals; gyros, synchros and servo mechanisms; orientation in aviation guided missiles.

*Personnel Eligible*—All Navy and Marine Corps male enlisted personnel having: 36 months' obligated service; combined GCT and ARI score of 115, with a minimum score of 50 on each, and a MECH score of 55; graduated from Class "P" Aviation Fundamentals School (Electronics Occupational Group) or equivalent knowledge; normal color perception and hearing. Confidential clearance required.

• **CLASS "C" AIR LAUNCHED GUIDED MISSILES (General) MAINTENANCE COURSE**—(Enlisted)—23 weeks. Provides selected candidates with the theoretical and practical knowledge required for the maintenance of air launched guided missiles.

Successful completion of this course qualifies the student for change in rating to Aviation Guided Missileman. The curriculum offered covers the fundamentals of gyroscopes and guidance systems, components and theory of *Sparrow* missiles and related test equipment.

*Personnel Eligible*—ATANs with one year of duty with the fleet or ATs in pay grade E-4 and above. In addition, other personnel in Group IX ratings who have successfully completed the preliminary electronic training for rate conversion in accordance with BuPers Inst. 1440.13. Two years' obligated service and a Secret clearance is required.

• **CLASS "O" AIR LAUNCHED GUIDED MISSILES (General) MAINTENANCE COURSE**—(Officers)—23 weeks.

This school provides selected officers with the theoretical and practical knowledge required for the maintenance of Air Launched Guided Missiles.

*Personnel Eligible*—All officers on active duty having an adequate electronics background who are currently serving in or slated for assignment to an air-launched guided missile billet. Secret clearance required. OPNAV Inst. 1510.1F sets forth requirements.

# Here Are Study Guides for Guided Missileman Ratings

IF YOU ARE INTERESTED in advancing in rate or changing to one of the guided missile ratings, (either Guided Missileman (GS) or Aviation Guided Missileman (GF), perhaps the wisest move you can make would be to ask your division officer for a copy of the pertinent Study Guide. There are three issued for each rating—PO3, PO2, and PO1 and Chief. Based upon the *Manual of Qualifications for Advancement in Rating* (NavPers 18068, Rev.), each one tells what you must study for advancement in your chosen field.

One section of each study guide consists of a table listing the major subject areas. Each subject is associated with one or more study ref-



"I shot a missile into the air. It fell to the earth, I know not where."

erences and also with the one or more qualifications to which it pertains. Another section contains a list of the reference books needed. The third section covers advancement.

Below you will find a list of the publications to be used and studied in preparing for advancement exams. The manuals listed are those used by examining authorities in preparing questions for service-wide competitive examinations, although in practically all cases only parts of the books listed will apply to a particular rate. As you know, men trying for the higher grades in a rating are expected to know all the material required of the lower rates, plus that required for the rate they desire.

## Guided Missileman (Surface)—GS3

*BuShips Manual*  
*USN Safety Precautions, OpNav 34P1*  
 OP 2125  
 OP 2199, Vols. 1 and 2  
*Blueprint Reading, NavPers 10077-A*  
*Basic Hand Tool Skills, NavPers 10085*  
*Electricity for Fire Controlmen and Fire Control Technicians, Vol. 1, NavPers 10170*  
*Electronics Technician 3, NavPers 10188*  
*Fireman, NavPers 10520-A*  
*Machinist's Mate 3 & 2, NavPers 10524-A*  
*Electrician's Mate 3, NavPers 10548-A*  
*Damage Controlman 3 & 2, NavPers 10571-C*  
*Electricity, NavPers 10622-B*  
*Electronics for Guided Missiles, NavPers 10863*  
*Basic Hydraulics, NavPers 16193*

## Guided Missileman (Surface)—GS2

*BuOrd Manual*  
 OP 2199, Vols. 1 and 2  
*Human Behavior and Leadership, NavPers 10058*  
*Basic Electronics, NavPers 10087*  
*Electricity for Fire Controlmen and Fire Control Technicians, Vol. 1, NavPers 10170*  
*Electronics Technician 3, NavPers 10188*  
*Electrician's Mate 3, NavPers 10548-A*  
*Electricity, NavPers 10622-B*  
*Electronics, Administration and Supply, NavPers 10853*  
*Electronics for Guided Missiles, NavPers 10863*

## Guided Missileman (Surface)—GS1 and Chief

OP 1303  
 OP 2199, Vols. 1 and 2  
*Electricity for Fire Controlmen and Fire Control Technicians, Vol. 1, NavPers 10170*  
*Fire Control Technician 1 & C, Vol. 1, NavPers 10176*  
*Electronics, Administration and Supply, NavPers 10835*  
*Electronics Technician 3, NavPers 10188*  
*Electronics for Guided Missiles, NavPers 10863*  
*Radar Electronics Fundamentals, NavShips 900,016*  
*Radar System Fundamentals, NavShips 900,017*

## Aviation Guided Missileman—GF3

*Electronics for Guided Missiles, NavPers 10863*  
*Electronics Technician 3, NavPers 10188*  
*Electronics Technician 2, Vol. 1, NavPers 10190-A*  
*Physics for Electronics Technicians, NavPers 10095*  
*Electricity, NavPers 10622-B*  
*Aviation Electrician's Mate, NavPers 10319*

*Basic Hydraulics, NavPers 16193*  
*Aircraft Hydraulics, NavPers 10332-A*  
*Blueprint Reading, NavPers 10077*  
*Hand Tools, NavPers 10306-A*  
*USN Safety Precautions, OpNav 34P1*  
*BuAer Technical Note 15-48 (with Appendix)*  
*Basic Electronics, NavPers 10087*  
*Radar Electronics Fundamentals, NavShips 900,016*  
*Standard First Aid Training Course, NavPers 10081*  
*Basic Hand Tool Skills, NavPers 10085*

## Aviation Guided Missileman—GF2

*Flight Engineering, NavPers 10395-A*  
*Electronics for Guided Missiles, NavPers 10863*  
*Basic Hand Tool Skills, NavPers 10085*  
*Basic Electronics, NavPers 10087*  
*Physics for Electronics Technicians, NavPers 10095*  
*Supplementary Readings in Fundamental Naval Electronics, Part 1, NavPers 10808*  
*Electronics Technician 2, Vol. 1, NavPers 10190-A*  
*Radar Electronic Fundamentals, NavShips 900,016*  
*Electrician's Mate 1 & C, NavPers 10550-A*  
*Electrical and Electronic Symbols, Mil-Std-15A*  
*Aircraft Hydraulics, NavPers 16193*  
*BuShips Manual, NavShips 250-000-49*  
*Electronics Technician 3, NavPers 10188*  
*Electricity, NavPers 10622-B*  
*Aviation Electrician's Mate, NavPers 10319*  
*Aviation Ordnanceman 3 & 2, Vol. 1, NavPers 10345*

## Aviation Guided Missileman—GF1 and Chief

*Radar Electronic Fundamentals, NavShips 900,016*  
*Basic Electronics, NavPers 10087*  
*Radar System Fundamentals, NavShips 900,017*  
*Supplementary Readings in Fundamental Naval Electronics, Part 1, NavPers 10808*  
*Microwave Techniques, NavShips 900,028*  
*Timing Circuits, NavShips 900,013*  
*Electronics for Guided Missiles, NavPers 10863*  
*Fire Control Technician 1 & C, Vol. 1, NavPers 10176*  
*Gun Fire Control System, Mk 56, Op 1600 (Preliminary)*  
*U. S. Navy Synchros, Op 1303*  
*General Training Course for Petty Officers, NavPers 10055*  
*Aviation Supply, NavPers 10394-C*  
*Aviation Storekeeper, NavPers 10396-A*  
*Aircraft Instruments, NavPers 10333-A*  
*Electronics Technician 2, Vol. 1, NavPers 10190-A*  
*Electrician's Mate 1 & C, NavPers 10550-A*  
*Electronics Technician 3, NavPers 10188*

# THE WORD

## Frank, Authentic Advance Information On Policy—Straight from Headquarters

● **NUCLEAR WEAPONS MAN** — A major change in the enlisted rating structure has taken place with the establishment of the Nuclear Weapons Man (NW) general service rating.

This newest rating in the enlisted rating structure is based upon the urgent needs of the special weapons program. At present, this program is manned by ETs, EMs, GMs, AOs, IMs, MRs, MEs, AKs, YNs and similar ratings.

The new rating, as approved by the Secretary of the Navy, will provide personnel qualified in the electrical and mechanical maintenance of nuclear weapons. The highly technical electronic maintenance associated with nuclear weapons, however, will not be a duty of the new rating, but will be performed by an appropriate existing rating.

By the establishment of a rating to fit the special weapons program, personnel in the program will be given definite recognition, and provided with a clear path of advancement.

It is expected that interim qualifications for advancement in rating will be published by Chief of Naval Personnel directives. Final qualifications will be published in a forthcoming change to the *Manual of Qualifications for Advancement in Rating* (NavPers 18068, Revised).

● **ADVANCE STUDY FOR AT(B) SCHOOL** — If you are awaiting assignment to the Aviation Electronics Technicians Class "B" School, you will find it extremely beneficial if you take any or all of the following courses before reporting to the school:

### Group I—Enlisted Correspondence Courses

- (1) *Mathematics, Vol. 1, NavPers 91219*
- (2) *Mathematics, Vol. 2, NavPers 91220*
- (3) *Electricity, NavPers 91225*
- (4) *Electronics Technician 3, NavPers 91373-1*
- (5) *Electronics Technician 2, Vol. 1, NavPers 91374-1*
- (6) *Electronics Technician 2, Vol. 2, NavPers 91375*

### Group II—Navy Training Courses

- (1) *Essentials of Mathematics for Electronics Technicians, NavPers 10093A*
- (2) *Advanced Mathematics for Electronics Technicians, NavPers 10094*
- (3) *Basic Electricity, NavPers 10086*
- (4) *Basic Electronics, NavPers 10087*

These courses are not intended as a substitute for the advanced electronics training given at the AT(B) School but are recommended so you will have the fundamental knowledge required and they will further serve as a means of re-establishing good study habits.

ATs in pay grade E-5 and above should complete as many as possible, with a minimum of two, of the Navy Training Courses listed in Group II, particularly items (1) and (2).

Personnel in other ratings, such as ALs or other prospective enrollees in any of the conversion programs

that involve AT(B) School attendance, should make an attempt to complete all of the items in either Group I or II.

These lists are primarily intended for candidates to the AT(B) School, but are equally important if you are waiting assignment to the various schools under the GS, GF and AQ conversion programs.

● **ANNAPOLIS STADIUM** — Construction of a Navy-Marine Corps memorial stadium at the Naval Academy, Annapolis, Md., begins this spring as a memorial to everyone serving today in the Navy and Marine Corps as well as those who have earlier served.

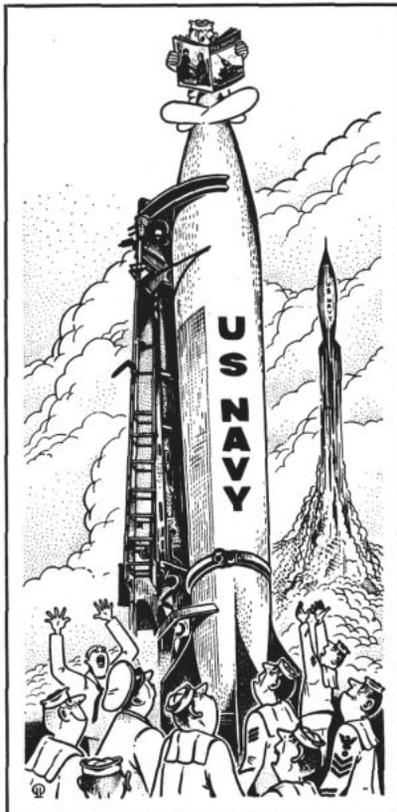
The stadium will be built with private funds. More than a million dollars has already been accumulated in a memorial stadium fund and construction will be started with this money. To raise the amount required to complete the stadium the Naval Academy Athletic Association has been receiving voluntary contributions.

While no solicitation of funds within the meaning of SecNav Inst. 5340.1A will be made, voluntary contributions may be accepted and sent directly to the Treasurer, Naval Academy Athletic Association, Annapolis, Md. Names of ships and stations contributing will be recorded on bronze plaques at the stadium.

● **ALs MAY CHANGE RATE TO RM** — Although the Aviation Electronicsman (AL) rating is being disestablished, some ALs apparently do not desire to make the scheduled conversion to Aviation Electronics Technician (AT).

If you are an AL and do not desire—or cannot qualify for—the AT conversion, you may be assigned to a radioman (RM) billet for employment directly in the performance of communications duties. Since the qualifications for AL and RM are similar in many respects, it is felt that this procedure will permit you to qualify for RM before the AL rating is terminated. For men in pay grade E-6 and below, this "on-the-job" training also offers an excellent opportunity for advancement.

Once assigned to a radioman billet, you may request a change in rating (in accordance with BuPers Inst. 1440.5B) as soon as you become qualified in RM duties. If you meet all qualifications except the



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speed requirements of the CW performance tests (transmitting and receiving), the Chief of Naval Personnel will consider requests for a delay in meeting the RM performance test speed requirements.

Commanding officers have been requested to report to the Chief of Naval Personnel on the progress being made by each of the 50 ALs who are being ordered to duty in large communication activities. The commanding officer will report after each man has completed six months' duty at the station.

• **STUDY GUIDE FOR FUTURE OFFICERS** — Do you have your eye on possible officer status? If so, in BuPers Inst. 1560.12 you will find a list of recommended study material which will be of interest to you.

It is, in the words of the instruction, "recommended for review for the examination administered to in-service personnel nominated for appointment to commissioned status under the Integration Program, the Limited Duty Officer Program, and the Warrant Officer Program (W-1)."

The Navy tests and correspondence courses listed will prove useful review materials for those naval knowledge questions included in part 2 of the examination—and the USAFI self-teaching materials, correspondence courses and examinations cover the educational requirements contained in part 3.

In each instance, you should choose either self-teaching material or correspondence courses depending on how thoroughly you need to review. If you find you need more background knowledge before studying the courses listed, you should

### Seawolf at Sea On Nuclear Power

uss *Seawolf* (SS(N) 575), second of the Navy's nuclear submarines, is currently undergoing builder's trials, including submergence tests, and is now operating at sea on nuclear power.

The submarine's trials were delayed several months by trouble with her heat transfer system, which uses liquid sodium as an agent, instead of the pressurized water used in uss *Nautilus* (SS(N) 571). The failures, which first occurred last August, have been overcome by repairs and modifications, including bypassing of the steam superheater.

consult the current USAFI catalog, in which prerequisites are suggested under each course description.

The I & E officer in each ship and station has been requested to cooperate with your division officer in making the material available.

• **EXAMS FOR TEMPORARY OFFICERS** — It is planned to introduce written examinations for USN temporary officers in fiscal year 1958, with the first examinations to be given for those selected for promotion in that year.

A forthcoming revision of BuPers Inst. 1416.1B will prescribe specific procedures for these examinations, including phasing of examinations and exemptions. (Instruction 1416.1B is concerned with the determination of professional fitness for promotion of officers. At present, temporary officers are exempted from the requirements.)

BuPers Inst. 1416.3 sets forth a study plan for the guidance of temporary officers in their selection of courses which will prepare them for higher grades. BuPers Notice 1416 (11 Dec 1956) which announces the introduction of written examinations for temporary officers, also urges each officer affected to develop himself through self study, using Instruction 1416.3 as a guide, both in preparation for examinations and to earn exemptions within specified fields corresponding to his category.

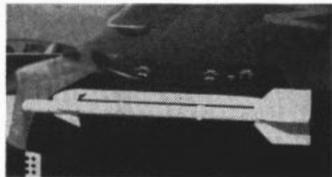
• **EMERGENCY RATING CHANGES** —The emergency service ratings of Boilerman G (Shipboard Boilerman) and Boilerman R (Boiler Repairman) will be dropped from the enlisted rating structure, according to BuPers Notice 1223 of 31 Dec 1956.

Directives setting forth the procedure for effecting the changes have not yet been published. Until they are promulgated, personnel holding the affected ratings will continue to advance in those ratings, and will not be changed from one rating to another.

Elimination of the two ratings was approved by the Secretary of the Navy after a study of findings presented by the Permanent Board for Review of the Enlisted Rating Structure. The board is responsible for the study and evaluation of all recommendations for new ratings and all recommendations for the elimination of ratings which no longer provide for the most effective use of naval manpower.

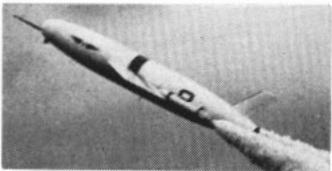
# QUIZ AWEIGH

This month's issue is devoted to Navy's efforts and developments in the guided missile field. As you well know, guided missiles are very much in the limelight today and certainly you as a Navyman should know as much about them as you can dig up. See how well you can recognize some of these missiles and "guide" yourself to a 4.0. If your radar gets jammed, turn to page 58 for guidance.



1. The above missile has been "cover missile" for a number of magazines and you might have seen it actually operate over television. It is the (a) Terrier (b) Regulus (c) Talos.

2. This missile is now used as the primary weapon of some ships and is a/an (a) air-to-air missile (b) surface-to-air missile (c) surface-to-surface missile.



3. You should easily recognize this (SSM) surface-to-surface missile as the (a) Loon (b) Petrel (c) Regulus.

4. During development of this missile, one of the outstanding features was that (a) this missile gave absolutely perfect readings (b) it was simple in design and cheap to build (c) it could be fitted with landing gear and used many times.



5. If you've read this issue over carefully, then you'll readily recognize this air-to-air (AAM) missile as the (a) Sidewinder (b) Sparrow (c) Petrel.

6. Another item related in these pages tells you that this missile received its name because it (a) has the uncanny sense of direction of a bird (b) was developed in the desert and has the sting of a rattler (c) is used mostly at sea.

# THE BULLETIN BOARD

## Guided Missile Orientation Courses for Officers Held At Norfolk and San Diego

To familiarize senior officers of the Fleet and shore commands with the functioning, capabilities and limitations of guided missiles, the Fleet Training Centers at Norfolk, Va., and San Diego, Calif., are conducting a series of Guided Missile Orientation Courses.

Attendance at both courses is limited to officers of the rank of LT, USN, (CAPT, USMC), and above. Since these courses are intended to acquaint senior officers with the developments in guided missile warfare, a technical background is not required. However in order to obtain the maximum benefits from the Guided Missile Orientation Courses, it is desirable that students be graduates of the Special Weapons Orientation or Employment Courses before they attend.

There is a quota for 24 students for each of the nine classes (GMO 28 through 35) scheduled from 26 Mar through 19 Nov 1957. Of that number 19 students are assigned through fixed quotas assigned to designated commands while the remaining five are assigned from BuPers controlled activities through individual requests to the Chief of



"But you may never get another chance to go down in naval history."

Naval Personnel (Pers C1235). A schedule of the convening dates and quotas for each class is published in enclosure (2) of BuPers Notice 1540 of 4 Dec 1956.

Requests for quotas to the five-day course (C380) at San Diego should be directed to the Chief of Naval Personnel (Pers C1235) or Commander Training Command, U. S. Pacific Fleet. Classes at San Diego convene on the first Monday of each month.

Personnel attending the Guided Missile Orientation Course at Norfolk should hold a Top Secret clearance, while a Secret clearance is required for the San Diego course.

## Learning How To Air Launch Guided Missiles

It takes more than instinct and a willing heart to make a good guided missileman. The Air Launched Guided Missile branch of the Naval Air Weapons Systems School at Jacksonville, Fla., is typical of the schools which provide the necessary training.

Commissioned in 1953, this school, the first of its kind in naval history, has supplied more than 500 highly qualified officers and enlisted personnel since its founding.

In the complex and technical field of guided missiles, the instructors are the most highly qualified technicians that it's possible to obtain within the Navy—and the level of training demands students of the same caliber. Small classes

assure the best opportunities for study.

The Air Launched Guided Missile branch presents a 23-week course in three phases of instruction. Phase I includes instruction on basic missile electronics, servomechanics M theory, gyroscopes, hydraulics and guidance systems.

Phase II teaches the operation of missile test equipment, component tests of missile sections, and component repair.

Phase III covers over-all systems test of the missiles and the systems test equipment.

Upon completion of the course, graduates are qualified to test, maintain, operate, and repair missiles and their associated test equipment.

## Books on Guided Missiles and Rockets Sent to Ships, Stations By Library Services Branch

Many aspects of the fields of guided missiles and rocket research are classified; however there are several books on these subjects which have been made available by the Library Services Branch of the Bureau to many ship and station libraries. Here are some of them.

**Guided Missiles in War and Peace**, by Nels A. Parson, Jr., is a good one with which to start. Here, you'll find a semi-technical briefing which covers the importance of this latest of weapons and explains its purpose as well as its construction. There is an explanation of air-to-surface, air-to-air, surface-to-air and surface-to-surface missiles, as well as the anti-missile guided missile developments. The aerodynamics, guidance and propulsion are described, and warfare use by the Navy, Air Force and Army is discussed. This survey of "bullets with brains" makes it possible for any Navyman to learn how they work—and why.

The historical angle, and the men who made rocket and missile history, may be found in **The Men Behind the Space Rockets**, by Heinz Gartman, a well known expert on rocket research.

The development is described by means of Hermann Ganswindt, the disregarded fanatic who produced the first realistic plan for a space ship; Tsiolkovski, the obscure Russian schoolmaster who bequeathed his research work to the Communist Party; Robert H. Goddard, the American professor who designed the first liquid-propelled rocket; Herman Oberth, the pioneer of German rocket research, who is now at work in America; and, says Gartman, perhaps the most brilliant of them all, Wernher von Braun, who was chief designer of the V-2.

**The Viking Rocket Story**, by Milton W. Rosen, tells how the largest American rocket to explore the upper atmosphere was conceived, how it was designed, built and launched. If you read the book, you'll learn that

Viking isn't just one rocket, it's a series. The book tells of the problems, frustrations, and triumphs accompanying the launching of each. Through skillful presentation, you'll come to know the men who build and fire each rocket, will see the rocket through their eyes and share their experiences.

**Rocket Pioneers**, by Beryl Williams and Samuel Epstein, is a rocket of another color. It provides an international roundup of the men of the last 150 years whose imagination and foresight glimpsed an era of transportation possible for all men in the years to come.

In his own way, each of these men contributed to such rockets as *Viking* and *Vanguard*, as well as to rockets of the future.

It begins with Sir William Congreve, who astounded the military men of Napoleon's time with a war rocket that was the forerunner of the present-day bazooka. It tells of Jules Verne, who stirred others to dream of ingenious space ships; of Tsiolkovsky, who provided the mathematics and basic theories that led others to the conviction that space ships would have to be powered by rocket motors. Contributions by Goddard, Oberth, von Braun, as well as many others, are also told here.

**Men, Rockets, and Space Rats**, by Lloyd Mallan, is slightly off the path of this month's theme, but if you liked the volumes earlier named, you'll like this one. Jaunty, respectful and conversational in style, it tells in considerable detail of the testing and actual construction being carried out by the Air Force and private concerns in connection with government laboratories. White Sands Proving Grounds, the *Aerobee*, the amazing deceleration and acceleration tests endured by Col. Stapp, and the research balloons (earlier described in *ALL HANDS*) are highlights of some of the chapters. They all add up to a fairly well rounded view of present and future space flights. Possibilities of actual space flights are discussed in the last chapter.

The *Vanguard* satellite is a mere child's step to the space travel boys who almost convince you that a jaunt to the moon or Mars is just around the corner. **The Exploration of Mars**, by Willy Ley and Wernher

## WHAT'S IN A NAME

### Target Drones

The shiny red propeller-driven miniature planes which have served as targets for much of the Navy's antiaircraft fire in recent years are making way for a bright new brother—a target drone whose turbojet engine affords near-sonic speed and altitudes approaching 40,000 feet. A target drone, incidentally, is defined as a remotely controlled, self-propelled airborne target system, and is designated by the letters "KD;" conventional planes, (such as the World War II F6F) which have been converted for use as remotely controlled targets, do not share the designation.

Known as the *Firebee*, or KDA-1, the new drone is a logical step in the development of an idea which dates from World War I. The military potential of automatically controlled aircraft was recognized as early as 1914, when the Germans are known to have shown an interest in them. In our country, the Naval Research Laboratory and Bureau of Aeronautics in the early 20s (see page 18) collaborated in the development of radio-controlled aircraft—one of our first steps in the development of guided missiles.

In September 1924, the first successful automatic aircraft flight in this country was made at Dahlgren, Va., when a pilotless seaplane under radio control took off, flew around and then landed without mishap. The guidance equipment, developed by the Naval Research Lab, bore many resemblances to later German-developed command guidance systems.

By 1935 a project was undertaken to convert obsolete planes into radio-controlled drones for use as antiaircraft gunnery targets. *USS Ranger* (CV4), in 1938, had the honor of being the first Fleet unit to fire against one of these drones, simulating a high-altitude bombing attack.

Since this introduction, target aircraft, either drone conversions of regular aircraft or specially designed small planes, have undergone many improvements and have become indispensable to Fleet training. Most sailors today are familiar with the



snappy red KD2R-3 and KD6D-1 or KD6D-2, conventional propeller-driven target drones which have been pulling duty with the Fleet for the past 10 years or so.

But prop-driven aircraft—even target drones—haven't much chance against the defense systems of a jet age Navy, hence the need for targets like KDA-1. *Firebee*, which weighs approximately 1800 pounds, is designed to simulate the maneuvers of piloted jet aircraft. It is less than half the size of a modern fighter, however, with a wingspan approaching 12 feet and an over-all length of approximately 18 feet.

The *Firebees* may be launched either from the ground or from a piloted "mother" aircraft. A two-stage parachute system is used to decelerate the plane from its near-sonic speed and lower it to the surface. This system operates automatically in case of a hit, loss of radio contact, engine failure or on command from the operator.

KDA-1's automatic pilot setup is somewhat similar to those used in earlier KDs, with command control signals being initiated manually at a remote control box. These are received by a unit in the drone which translates the signals into action. Closing the guidance loop is a radar plotting board which gives a continuous display of plan-position and altitude of the drone.

von Braun, and **Exploring Mars**, by Robert S. Richardson, are two examples.

*Exploration*, for instance, is a blueprint for actual travel laid out with such precision and confidence that you're inclined to reach for a time table. It discusses specifications of the ship, selection and training of crew members, and actual details of the trip. *Exploring* provides a be-

lievable description of a trip into outer space, how rocket travel may be achieved, and how to plot a course to Mars and the moon. The author provides astronomers' answers to questions concerning the life, climate and physical conditions of Mars, and tells you how you can locate it in the sky. You'll have to apply for your own reservations for the trip.

Other missile and rocket volumes available at your ship or station library include: *Satellite*, by Eric Bergaust and W. Beller; a somewhat technical volume entitled *Aerodynamics Propulsion Structures*, by E. A. Bonney and others, which is one of a series under the general title of "Principles of Guided Missile Design; Rocket Propulsion," by Eric Burgess; and *Frontier to Space*, also by Burgess; *Rockets and Missiles: Past and Future*, by Caidin; *Skyrocketing into the Unknown*, by Charles I. Coombs; *V-2*, by Walter Dornberger; *Development of the Guided Missile*, by Gatland; *Rockets and Guided Missiles*, by John Humphries; and *Rocket Propulsion Elements*, by George P. Sutton.

**DIRECTIVES IN BRIEF**

This listing is intended to serve only for general information and as an index of current *Alnavs* and *NavActs* as well as current *BuPers* Instructions, *BuPers* Notices, and *SecNav* Instructions that apply to most ships and stations. Many instructions and notices are not of general interest and hence will not be carried in this section. Since *BuPers* Notices are arranged according to their group number and have no consecutive number within the group, their date of issue is included also for identification purposes. Personnel interested in specific directives should consult *Alnavs*, *NavActs*, Instructions and Notices for complete details before taking action.

**Alnavs**

No. 67 — Announced approval by the President of reports of selec-

**QUIZ AWEIGH ANSWERS**  
**QUIZ AWEIGH IS ON PAGE 55**

1. (a) *Terrier*.
2. (b) Surface-to-air missile.
3. (c) *Regulus*.
4. (c) It could be fitted with landing gear and used many times over.
5. (a) *Sidewinder*
6. (b) Was developed in the desert and has the sting of a rattler.

tion boards which recommend USN and USNR officers for promotion to the grade of captain, Civil Engineer Corps; lieutenant commander, Medical Corps, Supply Corps, Chaplain Corps, Civil Engineer Corps, Dental Corps, Medical Service Corps, Nurse Corps; lieutenant, Line, Supply Corps, Chaplain Corps, Civil Engineer Corps, Medical Service Corps and Nurse Corps.

No. 1 — Announced change to Article C-9801, *BuPers Manual*, which is concerned with notification of aviation casualty.

No. 2 — Announced early construction of a Navy-Marine Corps Memorial Stadium at the Naval Academy, Annapolis.

No. 3 — Announced certain Navy publicity features during January.

No. 4 — Promulgated a basic change in the LDO procurement program.

No. 5 — Stated that certain companies operating within the state of Alabama and who were engaged in the sale of automobile insurance had been placed in receivership and policies cancelled.

**Instructions**

No. 1133.4A — Restates instructions permitting USN personnel who so desire to be discharged within one year of their normal expiration of enlistment for the purpose of immediate reenlistment.

No. 1440.20 — Outlines procedures for changing rating from *Teleman* to *Radioman* or *Yeoman*.

No. 1520.4B — Requests applications from USN and USNR officers of unrestricted line or LDO categories, other than aviation, for officer deep sea diving training.

No. 1560.12—Recommends study material for personnel who wish to plan a program of study in preparation for the exam administered those nominated for commissioned status.

**WAY BACK WHEN**

**The First Rockets**

Contrary to common knowledge and belief, the concepts pertaining to rockets and guided missiles are far from new. In fact, they're ancient.

History reveals that as early as 3000 B.C., the Chinese first used rockets. They were propelled by black powder and very similar to the skyrockets we use today on the Fourth of July. The Chinese also used them for celebrations and festivals.

Rockets were first used as a weapon of war about 1232 A.D. When defending the city of Pein-King, the Chinese attached arrows to rockets and used them not only as a weapon but as incendiaries.

News of the rockets spread fast and during the 13th and 14th Century history recorded a number of occasions during which they were used throughout Europe.

The idea of manned rocket flights is also far from new. As far back as the 15th Century the Chinese had their own "Captain Video"—named Wan-Hu, who attempted the first human rocket flight. He attached 47 rockets to a chair, secured two kites to its sides and then strapped himself in. As 47 coolies lighted the rockets at the same time, the Chinese scholar and scientists disappeared in a cloud of flame and smoke. History does not record the results of the flight, as Wan-Hu has not been seen or heard of since.

Interest in rockets as a weapon of war continued to spread and by the early 1790's Indian troops used over a hundred thousand of them against the British. They weighed from six to eight pounds, were made out of an iron tube and had a wire fitted with a 10-foot bamboo pole to



stabilize them in flight. As a result, the British immediately started a detailed study into the development of an artillery rocket. The outcome was such a success that they greatly influenced the results of the Napoleonic Wars and the War of 1812.

In 1846, William Hale, a U. S. inventor, developed the first stickless rocket. These early rockets had three curved vanes which caused them to rotate like an artillery shell. They came in two sizes—six and twelve pounds—and had a range of 2200 yards. During the year a rocket battery was formed at Ft. Monroe, Va., and by 1847 ten more batteries had been organized. These units were abolished shortly thereafter as interest in rockets began to lag when rifle and cannon companies proved to have increased accuracy during the Mexican War. Rockets came back into the foreground later, and today play an increasingly important role, as pointed out in the article on page 38.

# GUIDED MISSILES

## BEGINNING OF AN ERA

### ALL HANDS SPECIAL SUPPLEMENT

In the preceding pages, ALL HANDS has attempted to describe, within its limitations of time and space, what guided missiles are and how they are likely to affect every man in the Navy today and tomorrow. As you have seen in the historical summary on pages 18 through 23, guided missiles and their ancestors are not nearly so recent as most of us think. Why the sudden interest in these "new" weapons today? Below, you'll find an indication of the trend of thinking on the part of Navy planners.

*This unclassified material, somewhat condensed and revised for easier reading, has been made available as a special supplement through the courtesy of Guided Missiles Division, Office of DCNO (Air). Major portions of this report have appeared in the official Navy publication Combat Readiness.*

ON THE BASIS OF THE JOB to be done, the Navy's guided missile program is concerned with two fundamental requirements:

- To provide a Fleet air defense adequate to support naval operations in the face of strong enemy opposition.
- To provide our air, surface, and submarine striking forces with the capability of attack, utilizing the vast surfaces of the ocean areas and ready to be employed in the face of strong enemy defense.

These requirements stem from three simple realities:

- The gun is rapidly approaching obsolescence as a fully effective air defense weapon.
- International trends require that we view with concern plans that depend on certain foreign bases.
- In time, a competent enemy can be expected to develop defenses that will nullify, or make economically

impracticable, our present and near-future attack techniques involving aircraft.

A decade of heavy expenditures and development effort has gone into the creation of our nation's guided missile potential. That potential is now in hand. It offers the only known solution to our two basic requirements. At the same time, the Navy does not claim that guided missiles will replace all types of guns for all types of targets or for all types of wars. The Navy does not predict that they will eliminate the need for aircraft. It does not maintain that completely new strategies and tactics must be devised. But, the Navy does want to be sure that its forces are properly equipped with missiles and that its strategic and tactical concepts are responsive to the potentials of these instruments.

THE MISSILE—as we know it today—is not considered the ultimate weapon. It has its limitations. It raises the questions of electronic jamming; the possible future altitude and speed capabilities of aircraft targets with which defensive missiles must contend; and, for the offensive missiles, the issue of whether nuclear warheads will be used in all types of wars.



THE F3H2M *Demon* is capable of carrying the disarmingly graceful *Sparrow* air-to-air guided missiles.

However, the Navy is firmly committed to converting its guided missile potential into its Fleet capability; for it is recognized that the missiles, as such, represent no capability whatsoever. That capability lies only in the operating forces—the ships, submarines, aircraft and men who will use the missiles. The process of equipping the operating forces with missiles has just begun. The next four or five years will see the Navy so equipped both offensively and defensively, to a considerable extent. The operating forces during this period will perform an important role in perfecting these weapons and techniques.

As noted earlier, one of our two basic missile requirements is air defense. When we remember Pearl Harbor, Coral Sea, Midway, Okinawa, etc., the vital role of Fleet air defense in naval operations in the past is obvious. Today, it is even more vital. Today's aircraft have already relegated the best antiaircraft guns to emergency last ditch weapons. Tomorrow's aircraft and offensive missiles are tending to make the gun not only obsolete, but useless for all-around air defense. Today's aircraft and missiles can carry atomic payloads. Adequate air defense of a task group under such conditions must imply all-around protection and complete destruction of attacking forces. This must be a basic goal.

It should be borne in mind that, by the very nature of naval operations, these missiles are not "defensive" in the normal sense of the word. They are not intended to defend a ship or position for the sake of defense. Rather, their purpose is to guarantee that our striking forces can go into areas which enemy air power may choose to dispute.

SINCE GUNS are being outstripped by aircraft, air defense missiles are essential now in limited, non-nuclear wars where an air threat exists. Granted, a naval task group can more readily accept the hazards of conventional bombs than it can nuclear weapons. However, the fact remains that the gun is today less effective, and, if enough conventional bombs are dropped, life at sea can become unpleasant and dangerous.

In support of air defense, two categories of missiles are being developed:

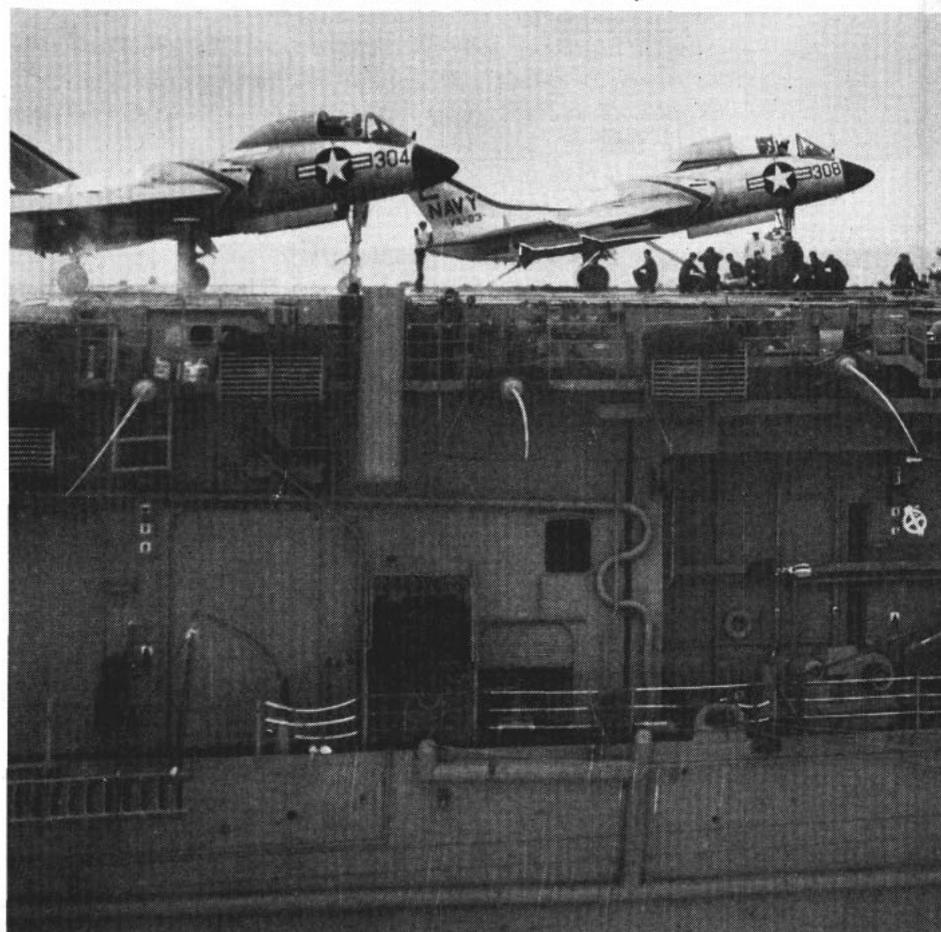
- **Surface-to-Air (SAM)**—These may be used from either a ship- or land-launching system.
- **Air-to-Air (AAM)**—These may be used from either carrier- or land-based aircraft.

In the surface-to-air category the Navy has three projects—*Terrier*, *Talos*, and *Tartar*—which are related, but are different in size and performance. These projects were begun primarily in support of the Fleet air defense requirements. The missiles, however, are adaptable to land-based use. A U. S. Marine Corps mobile *Terrier* system has been developed. The *Talos* land-based system has been under development for the Air Force for some time.

*Terrier* is launched with an auxiliary solid-rocket booster. After completing its job, the booster separates from the missile. The missile's solid-rocket sustainer is then ignited and maintains the missile at speed. *Terrier* is a beam-rider; the same radar which tracks the target also supplies the beam which the missile rides to that target.

The missile's "brain" determines the direction and distance of the missile from beam center and tells the control system to apply the aerodynamic corrections to

SOMEWHERE in the 'Med', *Cutlasses* armed with *Sparrow* air-to-air missiles



bring the missile back to beam center and on to the target.

The Operational Development Force has completed a service evaluation of *Terrier*, and the first *Terrier* ships have joined the Fleet. USS *Boston* (CAG 1) and *Camberra* (CAG 2) have been converted to guided missile ships through replacement of the after 8-inch turrets by two twin *Terrier* launchers, together with their magazines and fire control systems.

The fiscal year 1956 Shipbuilding and Conversion Program contained three new construction DLGs—5,300-ton frigates with one twin *Terrier* launcher each. Additional cruiser conversions and new DLGs are scheduled for later shipbuilding and conversion programs. However, it will be quite some time before every task group can boast an adequate quota of *Terrier* defenders.

**T**HE NEXT OF OUR SAM missiles to be operational will be the *Talos*. *Talos* is a long-range missile and provides tremendous killing power in its role in Fleet air defense. It operates out into ranges at present reached only by interceptors, and is going to exert a big impact on Fleet operations.

The first *Talos* ship was in the fiscal year 1956 Shipbuilding and Conversion Program as a conversion of USS *Galveston* and should be operational in fiscal year 1958. One twin-launcher and missile magazine will be installed aft. Additional cruiser conversions are planned and the first nuclear-powered cruiser is slated for a full *Talos* capability.

The third missile of the team is the newest and smallest—the *Tartar*, which is a blood-brother of the improved *Terrier*. It offers savings in technical effort,



NEW MEMBER of the Navy's guided missile family, the snub-nosed Sidewinder, nestles under wing of a Cougar.

money, and production facilities. *Tartar* is designed for use from ships as small as DDs and for secondary battery use from larger ships. The first application of this weapon will be to new destroyers in the fiscal year 1957 Shipbuilding and Conversion Program. The effectiveness of *Tartar*, in spite of its small size, will be greater than the first operational *Terrier*.

**H**OW ARE THESE missiles going to be used? The answer to this question brings up the problem of defense in depth—not protection of a point or a single ship. Task group air defense means detection, identifica-

tion, classification, control, coordination, and destruction of targets in a large area. Air defense of a single task group today is a big problem—and involves a big area.

Where do the air-to-air missiles fit into this defense? These missiles, which are becoming the primary fighter aircraft armament, are also vital to Fleet air defense. As the inner defense is taken over by surface-to-air missiles, air-to-air missile-armed fighters will push the defense perimeters farther and farther outward—making life increasingly difficult for enemy bombers.

The air-to-air missile-armed interceptors increase the effectiveness of high altitude air defense, plug the gaps in low altitude defense which exist below radar horizons, and go out to meet enemy bombers who hope to launch air-to-surface guided missiles at considerable distance from the task group.

In actual practice, air-to-air missiles are capable of attacking in three dimensions. This is the "jump-up"

are readied for launching from the flight deck of USS *Intrepid* (CV 11)



capability—the ability to hit targets at altitudes above or below the launching aircraft.

With the capabilities of these weapons, there is little reason to question their adoption as primary armament for our fighters. These air-to-air missiles should give us an extremely effective Fleet air defense—real defense in depth.

**T**HE PROJECTS mentioned so far relate to air defense. What about attack? There are two categories of missiles that meet the requirements:

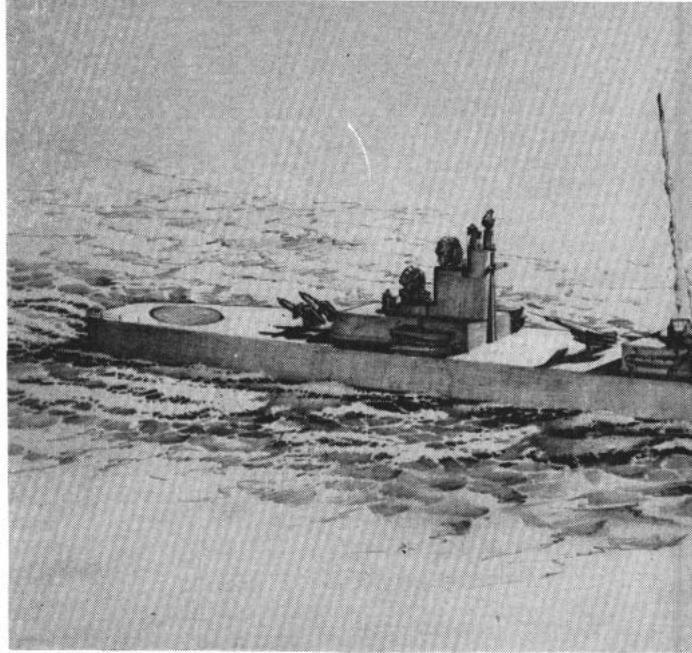
- **Air-to-Surface (ASM)**—These may be used from either carrier- or land-based aircraft.
- **Surface-to-Surface (SSM)**—These may be used from either surface ships or submarines.

Before the guided missile era, an attack by aircraft could be accomplished with reasonable success and with relatively low losses. Today, however, it must be assumed that a potential enemy will be equipped with defensive guided missiles reasonably similar to our own. This is inclined to discourage bombing and torpedo-delivery techniques. The more powerful the enemy's defense, the greater the need for accurate attack from a distance. This is the role of the air-to-surface missile.

In the air-to-surface category, the Navy has several active weapon projects.

However, developments in this field rapidly approach a point of diminishing returns, particularly when restrictions on the size- and weight-carrying capacity of Navy attack aircraft are considered. A point is reached where it becomes more practical and economical to launch missiles from the surface, rather than carry them part of the distance by aircraft.

**EVEN SUCH 'thinking machines' as guided missiles depend on manpower. Here crew jockeys Sparrow into wing launcher of Cutlass jet fighter.**



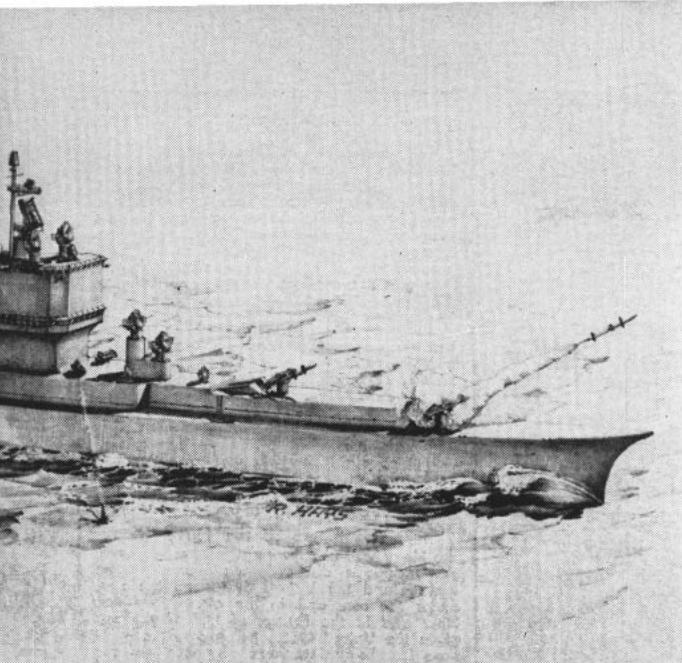
**NAVY'S FIRST** nuclear-powered guided missile cruiser, which is the inevitable trend toward an atomic Navy. Shown in picture

This brings us to the surface-to-surface category. Here, the Navy can make a significant contribution. If another global conflict develops, first-choice targets of the enemy will presumably be our land-based retaliatory forces, both in the United States and overseas. Those forces which are established on foreign land bases may be more vulnerable to enemy surprise attack. Naval attack missile forces, however, because of their mobility, and their ability to cover the world's oceans, give us a tremendous offensive capability against the enemy, a capability that defies not only defense but attack.

**T**HE SURFACE-TO-SURFACE MISSILE lends itself to use by either surface ship or submarine. Its use by the submarine, however, that may pay the greater dividends. With almost no supporting forces, individual guided missile submarines can operate in the face of strong defense in widely dispersed areas. In theory, at least, this appears an ideal way of keeping our potential enemy continually on the alert.

Before discussing the separate Navy surface-to-surface programs, several factors should be considered:

- Surface-to-surface missiles of intermediate or long range are capable of carrying nuclear warheads.
- Guided missiles carrying nuclear warheads are primarily deterrent or all-out war weapons.
- The very nature of a cold war calls for this type of weapon, ready for use now.
- The possibility of an indefinite cold war not only means that we



scheduled for 1957 shipbuilding program, will definitely continue is an artist's conception of how the cruiser will appear when built.

*Regulus II*—is planned as an operational successor to *Regulus I*. Its increased speed and altitude will make it a more effective weapon.

*Polaris*—is the Navy's IRBM (intermediate range ballistic missile) capable of being fired from submarines at land targets. It may also be fired from surface ships and is an important factor in future planning.

**T**HIS DISCUSSION has been restricted to the Navy's guided missile efforts which may be expected to produce operational results within the next four to five years. Beyond this period there are broad areas of possibilities.

Some day the "ultimate weapon" may be produced. But until that day arrives and until the ultimate character of such a weapon is established, it must be remembered that war is not only a matter of technological superiority of weapons, but also of the strategy, tactics, and logistics related to their use. It cannot be assumed that, at any given future date, we will enjoy a technological superiority over our prospective enemy. In fact, it is not wise for us to make such an assumption.

But granting the enemy technological equality—or even slight technological superiority in some fields—we need be seriously concerned only if we are denied the freedom to attack from the high seas. To retain this freedom of action the Navy must remain strong. This calls for a Navy equipped with both offensive and defensive guided missiles.

*(A fuller discussion of this material may be found in the source from which the foregoing was extracted—"Combat Readiness"—a Navy Department classified publication.—ED.)*

cannot wait for a hypothetical ultimate weapon, but we must plan improvement, and replace our present weapons. In other words, there can be no guarantee against obsolescence.

Because of this, the Navy's philosophy in surface-to-surface missiles provides that:

- The present Navy operational attack missiles must be combined with the present aircraft attack capability to provide the offensive power we need today.

- A continuing program of improvements in, or replacement of, missiles has to be followed. If not, our present missiles will soon be obsolete.

- Each step in this program means higher speed, higher altitude, longer range, or increased immunity to countermeasures on the part of our missiles.

Our naval forces, because of their inherent mobility and flexibility, and because they need not depend on overseas bases, will assume a major role in offensive missile warfare.

In practice, Navy planning provides for these missiles:

*Regulus I*—may now be used by submarines, cruisers, and carriers. This missile is launched by auxiliary solid-rocket boosters or from carrier steam catapults, and can be fitted with an atomic payload. At the present time, many carriers, four cruisers, and two submarines are equipped to use *Regulus*. Additional submarines are under conversion or construction. Increased use of the *Regulus* by submarines may be expected (see page 24).

**NOW A FAMILIAR** sight, surface-to-surface behemoth of the Navy's guided missile program is being prepared for a graceful JATO launching.

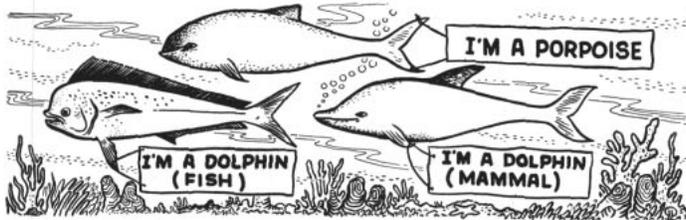


# TAFFRAIL TALK

REMEMBER THE STORY about the factory-worker who left the plant every night pushing a wheelbarrow full of straw? The guard at the gate was naturally suspicious so, time after time he searched the straw for company property, but he never managed to find any. Finally, his curiosity got the best of him and he stopped the worker and said, "Listen, I know you've been swiping something, and I'm sure it isn't straw. But, I'll promise not to report you if you'll only let me know what it is."

"Okay," confided the worker, "since you promise not to tell, I'll let you in on the secret—I've been taking wheelbarrows."

Well, back in December '56, we carried a one-page photo story on "Ice 'Bound' Animals," which we called "a photo-



graphic 'zoo' of frosty critters captured by alert Navy photogs as their ship made passage through Arctic or Antarctic waters." One of these "frosty critters"—a "porpoise"—was shown leaping in the air to accept a fish from a man in whites.

This started a flood of letters, and also a letter of Flood's—CWO R. J. Flood, USN, that is—who addressed his to the "Associate Editor, Nature-Faking Department." He pointed out that the animal shown does not frequent polar water, that it is a "bottle-nosed porpoise" residing in the outdoor aquarium at Marineland, Fla., and that the man feeding it is not a Navyman, but a civilian attendant dressed in a sailor suit.

Mr. Flood was right on all counts but one—technically the critter isn't a porpoise—it's a dolphin. Most of our other critics overlooked that mistake too.

So, hats off to the Nature-Faking Department. You did manage to heist one wheelbarrow anyway.



We have a note from our Editor-in-Charge-of-Credit-Where-Credit-Is-Due. He tells us that it might be well to credit the Bureau's chief photographer, Walt Seewald, and his associates, for their loyal and unflagging assistance to ALL HANDS Magazine. Mr. Seewald, it is, who processes pictures taken by staff members on field trips, who sets up and photographs rush jobs for our art department's illustrations and for photos for the magazine. One "for instance," for instance, is the back cover of this issue. Mr. Seewald did it as he has done so many other fine ones. The people in the picture, incidentally, are: CAPT J. A. Obermeyer, USN, CO of the naval unit at Massachusetts Institute of Technology, and ENS J. T. Tidwell, USNR, who portray the oath-taking at commissioning—the oath to defend the Constitution of the United States against all enemies, domestic or foreign—the oath of an officer of the U. S. Navy.

*The All Hands Staff*

## The United States Navy

### Guardian of Our Country

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends. The United States Navy exists to make it so.

### We Serve with Honor

Tradition, valor and victory are the Navy's heritage from the past. To these may be added dedication, discipline and vigilance as the watchwords of the present and future. At home or on distant stations, we serve with pride, confident in the respect of our country, our shipmates, and our families. Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

### The Future of the Navy

The Navy will always employ new weapons, new techniques and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war. Mobility, surprise, dispersal and offensive power are the keystones of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past. Never have our opportunities and our responsibilities been greater.

**ALL HANDS** the Bureau of Naval Personnel Information Bulletin, with approval of the Bureau of the Budget on 23 June 1955, is published monthly by the Bureau of Naval Personnel for the information and interest of the naval service as a whole. Opinions expressed are not necessarily those of the Navy Department. Reference to regulations, orders and directives is for information only and does not by publication herein constitute authority for action. All original material may be reprinted as desired if proper credit is given ALL HANDS. Original articles of general interest may be forwarded to the Editor.

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The Bureau invites requests for additional copies as necessary to comply with the basic directive. This magazine is intended for all hands and commanding officers should take necessary steps to make it available accordingly.

The Bureau should be kept informed of changes in the number of copies required. The Bureau should also be advised if the full number of copies is not received regularly.

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● AT RIGHT: FLYING SNAKES — Guided Missileman Third Class C. C. Regg, USN, and F. D. Adair, AN, USN, push Sidewinders toward FJ-3 fighter of Squadron VF 143 at Naval Air Station Miramar, California.





**" I WILL SUPPORT AND DEFEND  
THE CONSTITUTION OF THE UNITED STATES  
AGAINST ALL ENEMIES, FOREIGN OR DOMESTIC "**